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THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 66 MAY, 1938 No. 1

NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV., AN ACANTHOCEPHALAN PARASITE OF MANIS JAVANICA DESMAREST

By MARCOS A. TUBANGUI and VICTORIA A. MASILUNGAN

Of the Bureau of Science, Manila

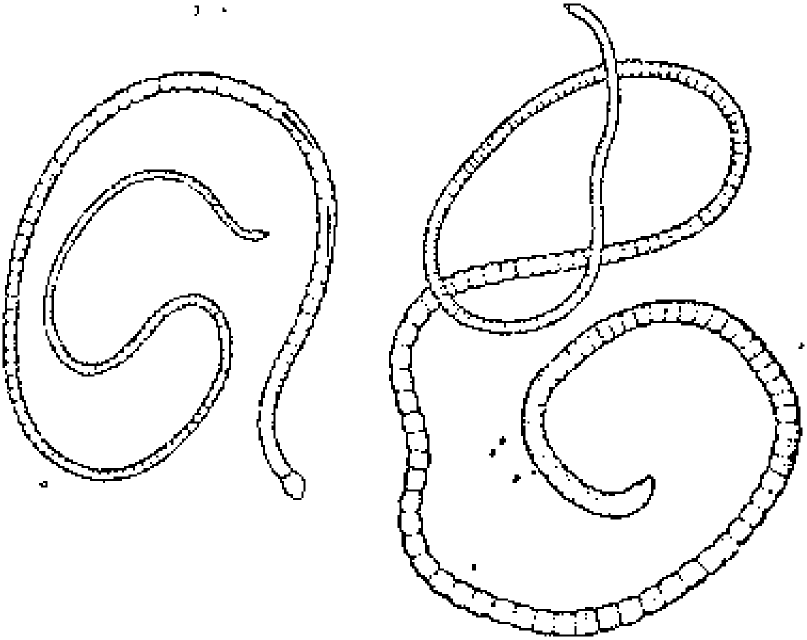
ONE PLATE AND ONE TEXT FIGURE

Among some helminths found in the intestines of a pangolin, *Manis javanica* Desmarest, 1882, which was received for dissection through the courtesy of Dr. C. Manuel, of the Fish and Game Administration of the Bureau of Science, were a number of mature and immature specimens of what appears to be a new species of proboscis worm. Recently Meyer (1931) described from *Manis tricuspis*, the African pangolin, *Nephridiocanthus manisensis*, with which the Philippine parasite was thought to be at least congeneric. A closer examination of the specimens, however, showed definitely their position in the genus *Nephridiorhynchus* Meyer, 1931. For this reason the name *Nephridiorhynchus palawanensis* is proposed for the new parasite.

Description.—Adult worms very elongate, cylindrical, slightly compressed laterally, distinctly pseudosegmented except near extreme anterior and posterior ends. Anterior third or fourth of body length in both sexes smaller in diameter and much lighter in color; rest of body grayish. Male smaller than female, 190 to 280 millimeters long by 2.2 millimeters in dorsoventral diameter; female 210 to 360 by 2.3 to 2.6 millimeters.

Proboscis with an apical papilla, subspherical, 0.47 to 0.50 by 0.40 to 0.42 millimeter, armed with 48 hooks arranged in 8 anteroposterior rows of 6 hooks each, or, using another terminology, in 6 spiral rows of 8 hooks each. Hooks with more or less prominent subterminal barbs except those of last two posterior rows, varying in size, the first and fifth circles of hooks being largest and those of the seventh and eighth rows smallest, as shown by the following figures:

Row.	Length of hooks. μ
1	98.3–105.8
2	75.6– 92.6
3	75.6– 96.4
4	75.6– 90.7
5	98.3–102.0
6	90.7–100.0
7	75.6– 83.0
8	75.6– 83.0



Nephridiorhynchus palawanensis sp. nov., natural size. a, Male; b, female.

Neck slightly shorter than proboscis, free from spines, with a pair of large lateral papillæ near its junction with proboscis.

Proboscis sheath double-walled, 1.5 to 1.6 by 0.50 to 0.58 millimeters. Nerve ganglion large, oval, behind middle of length of proboscis sheath.

Lemnisci 6.5 to 11.0 millimeters long, one usually longer than the other, each with a small central canal and five large oval nuclei.

Testes elongated, one behind the other, 5.0 by 0.45 millimeters, separated by a distance of 4.5 to 6.5 millimeters, posterior testis about 26 millimeters from posterior end of body. Number of cement glands could not be definitely determined. Cement reservoir 4.8 by 1.2 millimeters. Bursa well developed and supported by rays like the bursa of certain nematodes.

Uterine bell 1.2 millimeters long, uterus proper 2.7 and vagina 0.4 millimeters.

Eggs oval, 68 to 72 by 47 to 53 microns, provided with three thick coverings; middle and inner shells separated by a space, outer shell pierced by numerous radial canallike structures leading to the surface and producing in the latter a punctate appearance.

Protonephridial organs appear as oval granular masses, one on each side of anterior extremity of uterine bell of adult female. Chief longitudinal vessels of subcuticula consist of a dorsal and a ventral canal.

The immature worms resemble in external appearance *Oligacanthorhynchus pomatostomi* (Johnston and Cleland, 1911) Tubangui, 1933, a larval Acanthocephala found encysted under the skin of birds in Australia and the Philippines. In the morphology of the proboscis, however, and other anatomical details, they agree with the adult parasites, as described above. The males measure 4.2 to 8.0 by 0.75 to 0.85, the females 5.4 to 14.6 by 0.85 to 0.95 millimeters. Proboscis 0.38 to 0.42 by 0.39 to 0.44 millimeter, proboscis sheath 0.95 to 1.10 by 0.33 to 0.35 millimeters. Proboscis hooks practically as large as those of adult worms. Lemnisci 5.6 to 5.9 millimeters long. Testes oval, one immediately behind the other, 0.15 to 0.30 by 0.08 to 0.11 millimeter.

Host.—*Manis javanica* Desmarest, 1882.

Location.—Small intestine.

Locality.—Palawan Island.

Type specimens.—Philippine Bureau of Science parasitological collection No. 526.

The new parasite differs from *Nephridiorhynchus major* (Bremser, 1811) Meyer, 1931, the type and thus far the only species of the genus, in the following respects: (*a*) it is much bigger, being at least three to four times as long as *N. major;* (*b*) the last two rows of proboscis hooks are not barbed, while in *N. major* it is the first two rows of hooks that are not provided with barbs; (*c*) the lemnisci possess only five nuclei each instead of nine, like *N. major;* (*d*) the eggs are smaller and the external shell covering differs in structure from that of *N. major.*

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TUBANGUI, M. A. Notes on Acanthocephala in the Philippines. Philip. Journ. Sci. 50 (1933) 115-128.

ILLUSTRATIONS

PLATE 1. NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV.

FIG. 1. Anterior end, showing proboscis, proboscis sheath, and lemnisci.
2. Proboscis, showing arrangement of hooks.
3. Cross section through proboscis sheath.
4. Posterior end of female, showing protonephridial organ, uterine bell, uterus, and vagina.
5. Egg.

TEXT FIGURE

Nephridiorhynchus palawanensis sp. nov., natural size. *a*, Male; *b*, female.

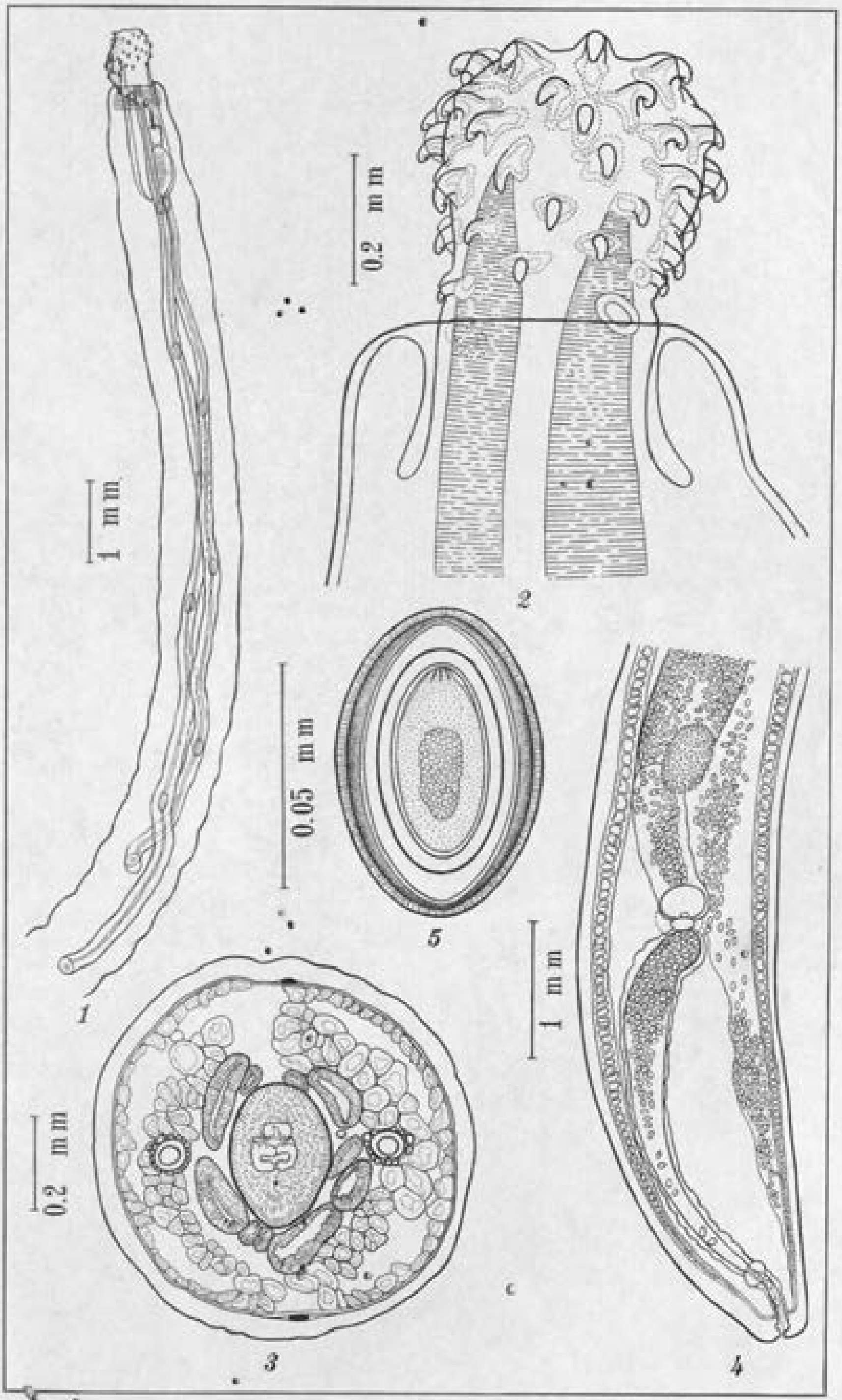

PLATE 1. NEPHRIDIORHYNCHUS PALAWANENSIS SP. NOV.

NEW OR NOTEWORTHY LOWER FUNGI OF THE PHILIPPINE ISLANDS, II [1]

By E. F. Roldan [2]

Of the Department of Plant Pathology, College of Agriculture, Los Baños Laguna

FOUR PLATES

This paper is the second [3] of a series of articles reporting new or noteworthy lower fungi of the Philippine Islands. In this article twelve species of lower fungi are recorded; six of these are described as new, and six as recorded for the first time from the Philippines. The material has been collected by the writer.

The type specimens of the six new species are deposited in the Baker Herbarium of the Department of Plant Pathology, of the College of Agriculture, Los Baños, Laguna, Philippine Islands.

CERCOSPORA VAGINAE Kruger.

Cercospora vaginae Kruger in Mededeel. Zuiker. West Java (1896) 29.

The fungus produces bright-red irregular patches, visible from both sides, on the leaf sheaths of sugar cane. The spots may increase in size and become confluent. The lesions may involve extensive areas, causing blight of the leaf sheath, and bringing about premature death of the leaves (Plate 1, fig. 4).

Mycelium effuse, olive brown, septate. Conidiophores arising from mycelium, erect, short, simple, solitary. Conidia subclavate or subcylindric, hyaline, pleurogenous, 0- to 3-septate, 12.5 to 37 x 3 to 6.5 μ (Plate 3, fig. 1).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 35*, June 19, 1936, on living leaf sheaths of *Saccharum officinarum* Linn.

This fungus was described by Kruger in Java in 1896 as causing red blight on the leaf sheath of sugar cane. It was later reported from Mauritius, Cuba, Puerto Rico, the West Indies, and Brazil. It is new to the Philippines.

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[1] Contribution No. 1227 from the Experiment Station of the College of Agriculture, Los Baños, Laguna. Published with the approval of the Dean of the College of Agriculture.

[2] The writer acknowledges his indebtedness to Dr. Eduardo Quisumbing, of the Bureau of Science, Manila, for comments and criticisms.

[3] The first paper of this series appeared in Philip. Journ. Sci. 60 (1936) 119.

CERCOSPORA FULIGENA sp. nov.

Caespitulis, sparsis, hypophyllis, brunneolus vel atro-brunneis, angularibus vel saepe venis limitatis; conidiophoris brunneis, simplicis, fasciculatis, subgeniculatis, septatis, 26 ad 67 x 3.7 ad 5 μ; conidiis clavatis vel subclavatis, lentiner curvatis, subhyalinis, acrogenis, 1 ad pluriseptatis, 15 ad 118 x 3.5 ad 5 μ.

The fungus forms thin brown to dark-brown colonies on the undersurface of the leaf. Colonies angular, indefinite, sometimes limited to veins. Conidiophores brown, simple, fasciculate, subgeniculate, septate, 26 to 67 x 3.7 to 5 μ. Conidia clavate to subclavate, slightly curved to subhyaline, 1- to several-septate, acrogenous, 15 to 118 x 3.5 to 5 μ (Plate 3, fig. 2).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 32*, March 5, 1934, on living leaves of *Lycopersicum esculentum* Mill.

Cercospora cruenta Sacc., causing leaf spot on tomato, was reported from the United States. *Cercospora fuligena* appears to be distinct from *C. cruenta* in that the Philippine species does not produce spots. Instead it forms dark-brown colonies composed of tufts of conidiophores on the undersurface of the leaves.

CYLINDROSPORIUM INSULARUM sp. nov.

Maculis 2 ad 30 mm diam., sparsis, orbicularibus vel lentiner irregularibus, centro giseolis, margine angusto brunneo cinctus; acervulis amphigeneis, plerumque hypophyllis, minutis, subepidermidem, nigris, sparsis vel gregariis; conidiophoris brunneis, septatis; conidiis clavatocylindraceis, lentiner curvulis, 48 ad 85 x 3 ad 4.5 μ.

The fungus produces few scattered circular spots on the leaf. Spots 2 to 30 mm in diameter, pale yellow, with narrow reddish border and gray center (Plate 1, fig. 1). Acervuli minute, black, subepidermal, amphigenous, most frequently hypophyllous, scattered or gregarious; conidiophores brown, septate; conidia cylindroclavate, curved, nonseptate, hyaline, 48 to 85 x 3 to 4.5 μ (Plate 3, fig. 3).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 38*, March 5, 1936, on living leaves of *Lansium domesticum* Correa.

This species appears to be the third of the genus reported from the Philippines, from an entirely new host. It has never been reported from *L. domesticum*.

MACROSPORIUM CENTAUREAE sp. nov.

Maculis 1 ad 15 mm diam., suborbicularibus, sparsis vel confluentibus, pallescentibus, flavis, zona rubelle-brunneis cinctus; conidiophoris amphigenis, maculicolis, brunneis, fasciculatis, subflexis, 21 ad 75 x 7 ad 7.5 μ, 3 ad 5-septatis; conidiis subclavatis, olivobrunneis, 42 ad 122 x 12 ad 17 μ, stipitatis, submuriformis, 4 ad 12-septatis.

The fungus produces spots 1 to 15 mm in diameter, irregularly circular, pale yellow, surrounded by a reddish brown border. The spots may be scattered or confluent, causing leaf blight which results in premature death of the leaves (Plate 1, fig. 3). Conidiophores maculicolous, amphigenous, fasciculate, brown, septate, subflexous, 21 to 75 x 7 to 7.5 μ, 3 to 5-septate. Conidia subclavate, olive brown, 42 to 122 x 12 to 17 μ, stipitate, submuriform, 4 to 12-septate (Plate 3, fig. 4).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 41*, June 12, 1936, on living leaves of *Centaurea* sp.

The fungus appears to be recorded for the first time on this host.

HELMINTHOSPORIUM HISPANIOLAE Cif.

> *Helminthosporium hispaniolae* CIFERRI in Estratii del Bolletino della R. Stazione di Pathologia vegetal di Roma 13 (1933) 222–308.

This fungus produces light-brown to pale straw-colored spots. At first the spots are irregularly circular, sometimes angular and limited to veins. Later they become circular. They may be scattered, or confluent and marginal. Old bottom leaves are most frequently infected (Plate 1, fig. 5). Conidiophores maculicolous, amphigenous, 0 to 3-septate, short, brownish, 14 to 74 x 3.5 to 4.5 μ; conidia cylindric, subclavate, hyaline 14.8 to 77.5 x 4.5 to 11 μ; 0 to 3-septate (Plate 3, fig. 5).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 24*, September 11, 1937, on living leaves of *Manihot utilissima* Pohl.

The fungus appears to agree closely in all its important characters with Ciferri's *H. hispaniolae*, and is considered identical with it.

ISARIOPSIS CLAVISPORA (B. & C.) Sacc.

Isariopsis clavispora (B. & C.) SACC. in New Jersey Agric. Expt. Sta. Bull. 13 (1917) 144.

The fungus produces numerous chocolate-brown spots 1 to 10 mm in diameter. The spots may be scattered or confluent, causing serious leaf blight (Plate 2, fig. 1). Conidiophores brownish, slender, filiform, densely fascicled, four to several in fascicle, tops loose and wavy, 60 to 220 x 4 to 4.5 μ, 1- to 2-septate. Conidia elongate, obclavate, olivaceous, 1- to 3-septate, 33 to 76 x 6.5 to 9 μ, guttulate (Plate 4, fig. 1).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 80*, September 15, 1937, on living leaves of *Vitis vinifera* Linn.

This fungus is widely distributed in the southern United States of America. It is not sure to be known in Europe. It is new to the Philippines.

ACROTHECIUM RUBIGINOSUM sp. nov.

Maculis 2 ad 20 mm latis, orbicularibus vel suborbicularibus, sparsis vel confluentibus, rubiginiis, centro atrofuscus, margin pallido flavida cinctus; conidiophoris maculiculis, hypophyllis, fuligenis, simplicibus, filiformis, fasciculatis, pluriseptatis, 45 ad 172 x 3.4 ad 4.6 μ; conidiis olivaceo-brunneis, 3-septatis, ovatis, orthotropis vel curvatis, 15 ad 27.5 x 7.5 ad 12.5 μ.

This fungus produces spots 2 to 20 mm in diameter, rusty brown, circular to subcircular. The spots, causing leaf blight, may be scattered or fused. Center of spot dark brown with light-yellow border (Plate 2, fig. 2). Conidiophores hypophyllous, maculicolous, brownish, simple, filiform, fasciculate, pluriseptate 45 to 172 x 3.4 to 4.6 μ. Conidia olive-brown, 3-septate, ovate, usually curved, sometimes straight, 15 to 27.5 x 7.5 to 12.5 μ (Plate 4, fig. 2).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 53*, August 11, 1936, on living leaves of *Eurycles amboinensis* (Linn.) Lindl.

This plant appears to be listed for the first time as a host of *Acrothecium rubiginosum*.

PIRICULARIA CANNAE sp. nov.

Areis, initio sparsis dein confluentibus, irregularibus, atrofuscus, centro pallescentibus brunneis; conidiophoris hypophyllis, laxa fasciculatis 4 ad 6, lentiner brunneis, simplicibus, 60 ad 125 μ, septatis; conidiis ovato-pyriformibus, lentiner brunneis, 1- ad 2-septatis, acrogenis, scorpoidis cyme, 35 ad 49 x 14 ad 21 μ.

This fungus produces dark-brown, irregular patches, scattered at first, later merging, producing blight in the leaves of the host plant (Plate 1, fig. 2). Conidiophores hypophyllous, loosely fasciculate in clusters of 4 to 6; slightly brownish, septate, simple, 60 to 125 µ long; conidia ovate-pyriform, septate, terminal in scorpoid cyme, 1- to 2-septate, 35 to 49 x 14 to 21 µ (Plate 3, fig. 6).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 43*, September 15, 1937, on living leaves of *Canna indica* Linn.

This fungus may be allied to *Piricularia grissea* (Ckc.) Sacc., on grasses, but it differs from the latter in having much larger spores.

MACROPHOMA PHASEOLINA F. Tassi.

Macrophoma phaseolina F. TASSI in Foreign Plant Diseases, a manual of economic plant diseases which are new to or not widely distributed in the United States. U. S. Dept. Agric. (1926) 136.

The fungus produces light-brown, usually marginal, but extensive and irregular, patches on the leaf of the host plant (Plate 2, fig. 3). Several patches may merge, causing severe leaf blight. Pycnidia maculicolous, amphigenous, more abundant above, scattered or gregarious, brownish, membranous, subepidermal, subglobular, 55 to 163 µ in diameter, ostiolate, not rostrate, 14 to 33 µ across the ostiole. Conidia subcylindric, granular, hyaline, 18.5 to 28 x 7.5 to 11 µ (Plate 4, fig. 5).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 46*, July 17, 1936, on living leaves of *Phaseolus vulgaris* Linn.

This fungus is reported as causing irregular pale-brown leaf spots of *Phaseolus ornithoppus* in Italy. More or less the same type of spot is produced on *Phaseolus vulgaris* in the Philippines. For lack of comparison with the type specimens the Philippine species is tentatively assigned to *Macrophoma phaseolina* F. Tassi.

PHYLLOSTICTA HEVEAE Zimm.

Phyllosticta heveae ZIMM. in Sylloge Fungorum 18 (1906) 223.

This fungus produces pale-brown patches at the tip or margin of the leaf, sometimes anywhere on the leaf blade. These patches have concentric zones (Plate 2, fig. 4). Pycnidia maculicolous, amphigenous, subglobular, subepidermal, erumpent, brownish, membranous, 60 to 160 µ broad, ostiolate, cells bordering ostiole dark brown, not rostrate, ostiole 15 to 20 µ across.

Spores minute, elliptic, hyaline, 5 to 7.5 x 2.3 to 3.4 μ (Plate 4, fig. 3).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 50*, August 16, 1935, on living leaves of *Hevea brasiliensis* (HBK) Muell.-Arg.

This fungus is common on Para rubber, causing marginal or apical brown patches on leaves, in Java, Trinidad, Brazil, and Malaya. It is new to the Philippines.

PHYLLOSTICTA PHYTOLACCAE Cke.

Phyllosticta phytolaccae CKE. in Sylloge Fungorum 3 (1884) 57.

This fungus produces spots 1 to 10 mm in diameter, numerous, circular, pale yellow, with narrow reddish-brown border, scattered or sometimes confluent. The numerous spots produced cause premature falling of the leaves (Plate 2, fig. 5). Pycnidia epiphyllous, minute, erumpent, scattered or gregarious, brownish, membranous, ostiolate but not rostrate, 63 to 148 μ, ostiole 14.5 to 37 μ. Conidia ovoid or elliptic, hyaline, 3 to 7 x 1.5 to 2 μ (Plate 4, fig. 4).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 27*, January 24, 1936, on living leaves of *Phytolacca dioica* Linn.

CICINNOBOLUS SIGACOLLUS sp. nov.

Hyphis fuscellus vel hyalinis, articulatis, erectis superficialibus; pycnidis in hyphis acropleurogenis, ovatis vel pyriformibus, minimis 48 ad 81 x 41 ad 56 μ, saepe stipitellata, membraceana, ochreo-brunneis, vertice pertusis; sporulis elliptico-oblongis vel ovatis, hyalinis, 4.5 ad 7.5 x 2.5 ad 3.5 μ.

This fungus is parasitic on the powdery mildew (Erysiphaceæ), very common on squash and other members of the Cucurbitaceæ. The fungous (*Cicinnobolus*) hyphæ intermingle with the hyphæ of Erysiphaceæ (Plate 2, fig. 6). Mycelium light brown to subhyaline, special hyphæ arising from it and bearing pycnidia which may be either acrogenous or pleurogenous. Pycnidia ovate or pyriform, 48 to 81 x 41 to 56 μ, stipitate, membraneous, ochre-brown, vertices protruding; spores elliptic or ovate-elliptic, hyaline, 4.5 to 7.5 x 2.5 to 3.5 μ (Plate 4, fig. 6).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 29*, July 18, 1937, on hyphæ of Erysiphaceæ, growing on *Cucurbita maxima* Duchesne.

This fungus is allied to *Cincinnobolus cesatii* de Bary, but has larger pycnidia and pycnospores.

ILLUSTRATIONS

PLATE 1

FIG. 1. Spots on a leaf of *Lansium domesticum*, caused by *Cylindrosporium insularum* sp. nov.
2. Patches on a leaf of *Canna indica*, caused by *Piricularia cannae* sp. nov.
3. Spots on leaves of *Centaurea* sp., caused by *Macrosporium centaureae* sp. nov.
4. Patches caused by *Cercospora vaginae* Kruger on the leaf sheaths of sugar cane.
5. Spots on a leaf of cassava, caused by *Helminthosporium hispaniolae* Cif.

PLATE 2

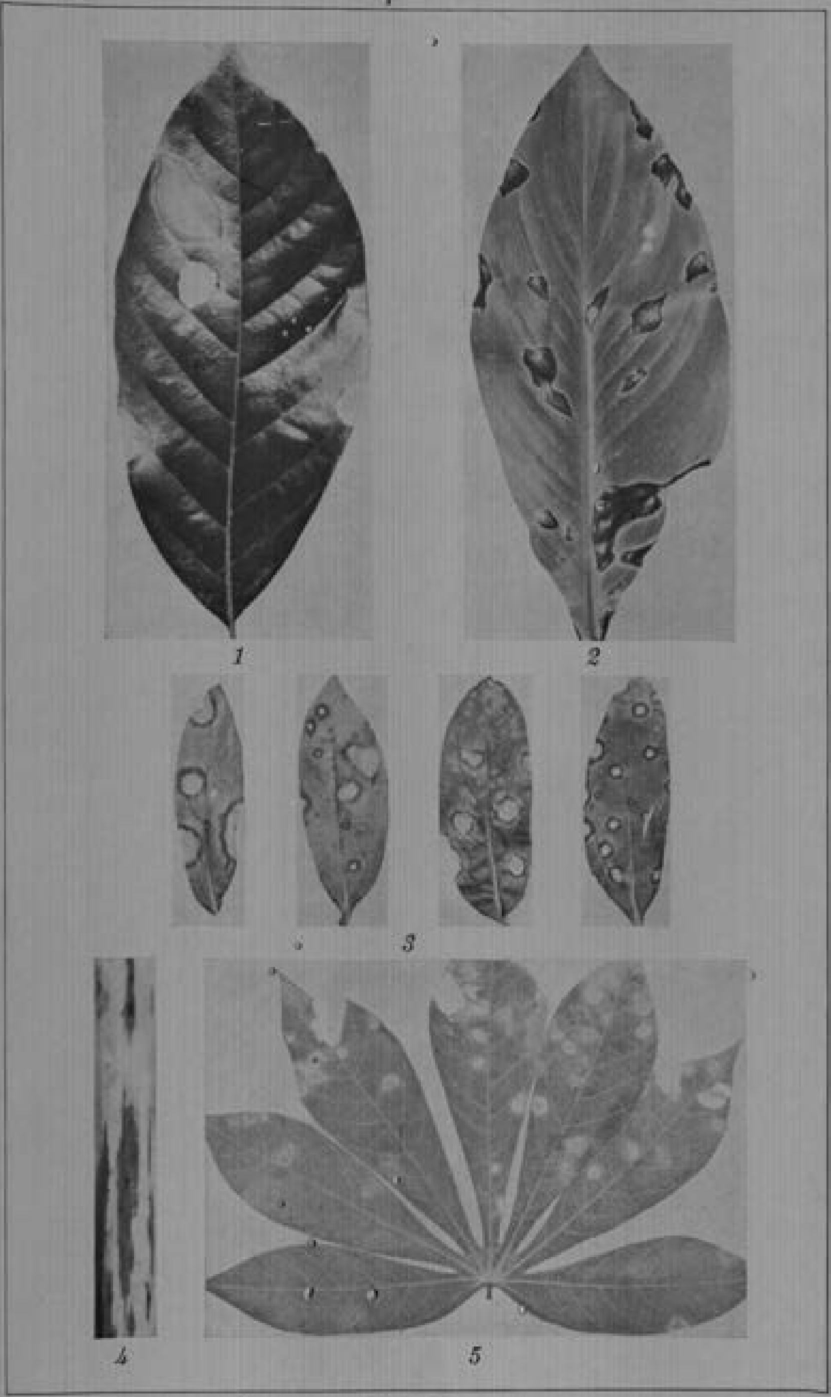
FIG. 1. Spots on a leaf of the grape, caused by *Isariopsis clavispora* (B. & C.) Sacc.
2. Spots on a leaf of *Eurycles amboinensis*, caused by *Acrothecium rubiginosum* sp. nov.
3. Blotches on leaves of *Phaseolus vulgaris*, caused by *Macrophoma phaseolina* F. Tassi.
4. Blight at the tips of leaves of Para rubber, caused by *Phyllosticta heveae* Zimm.
5. Spots on a leaf of *Phytolacca dioica*, caused by *Phyllosticta phytolaccae* Cke.
6. Colonies of Erysiphaceæ on which *Cicinnobolus sigacollus* sp. nov. is growing.

PLATE 3

FIG. 1. Conidiophores and conidia of *Cercospora vaginae* Kruger; × 1314.
2. Conidiophores and conidia of *Cercospora fuligena* sp. nov.; × 1314.
3. An acervulus of *Cylindrosporium insularum* sp. nov. in cross section, and conidia; × 1314.
4. Conidiophores and conidia of *Macrosporium centaureae* sp. nov.; × 1314.
5. Conidiophores and conidia of *Helminthosporium hispaniolae* Cif.; × 1314.
6. Conidiophores and conidia of *Piricularia cannae* sp. nov.; × 1314.

PLATE 4

FIG. 1. Conidiophores and conidia of *Isariopsis clavispora* (B. & C.) Sacc.; × 1314.
2. Conidiophores and conidia of *Acrothecium rubiginosum* sp. nov.; × 1314.
3. Pycnidia and spores of *Phyllosticta heveae* Zimm.; × 265.
4. Pycnidia and spores of *Phyllosticta phytolaccae* Cke.; × 265.
5. Pycnidium and spores of *Macrophoma phaseolina* F. Tassi; × 1314.
6. Pycnidia and spores of *Cicinnobolus sigacollus* sp. nov.; × 1314.



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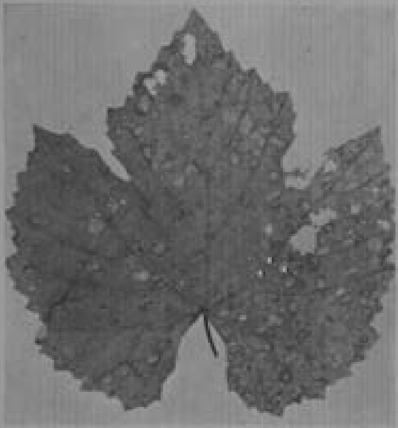

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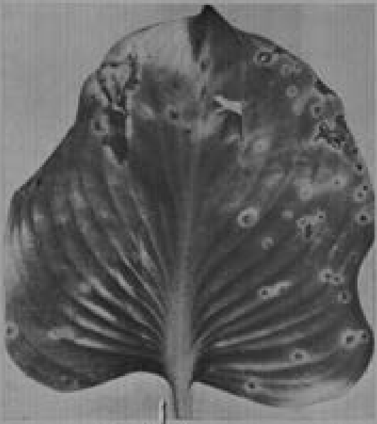

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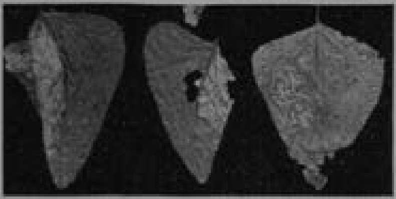

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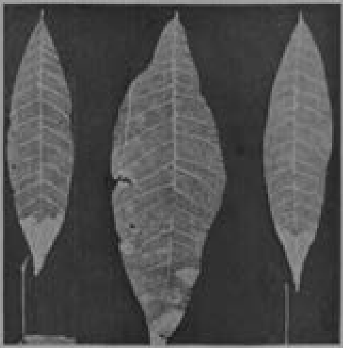

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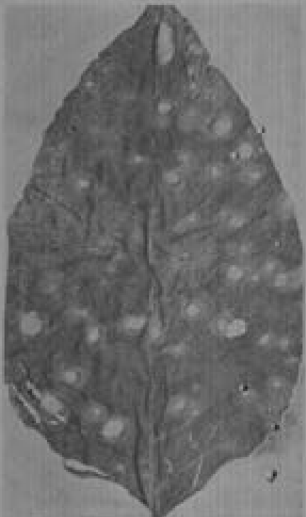

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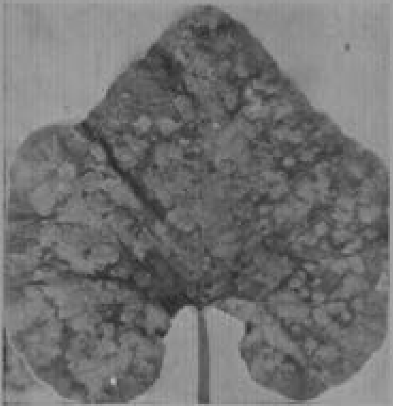

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PLATE 2.

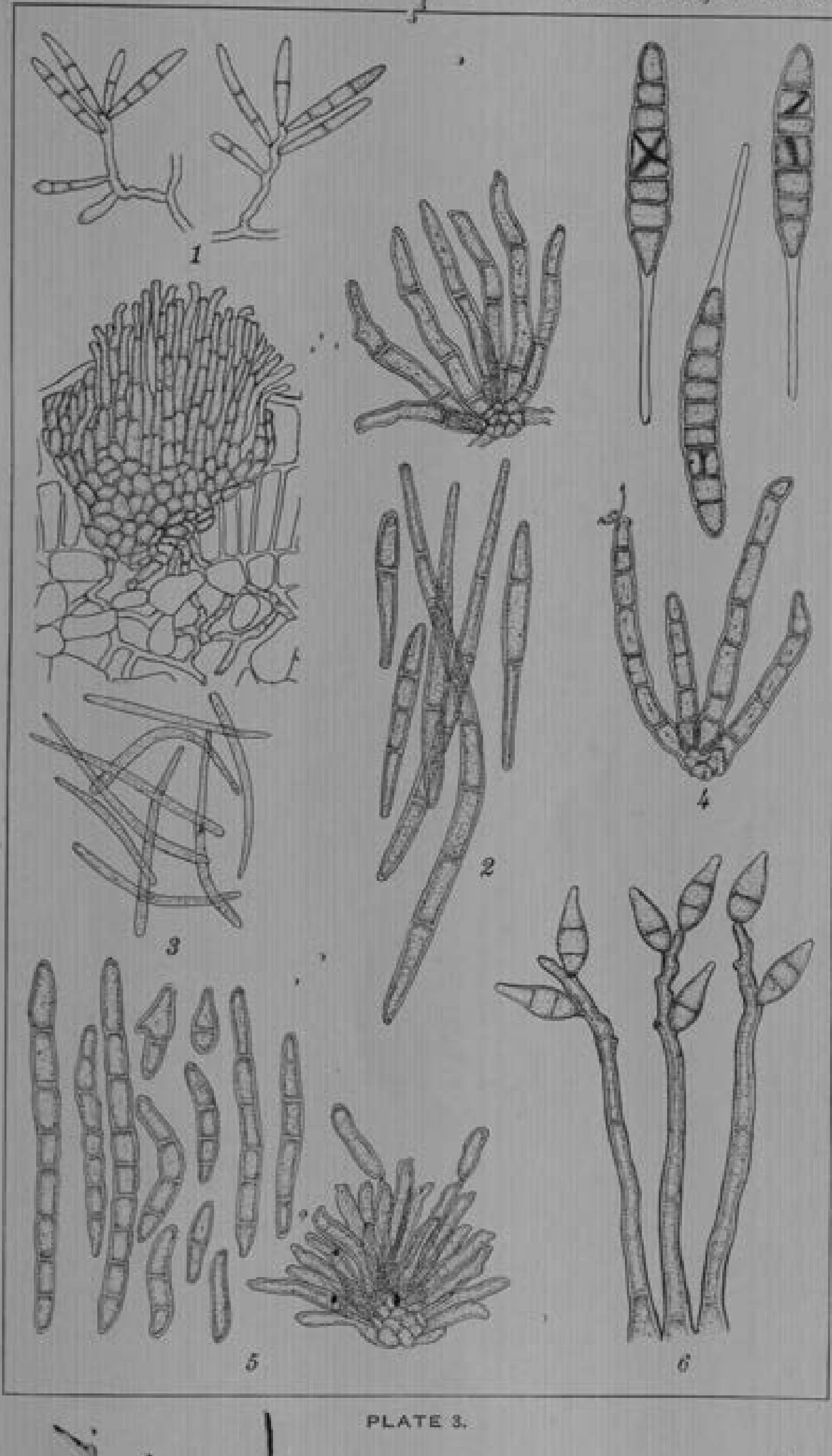

PLATE 3.

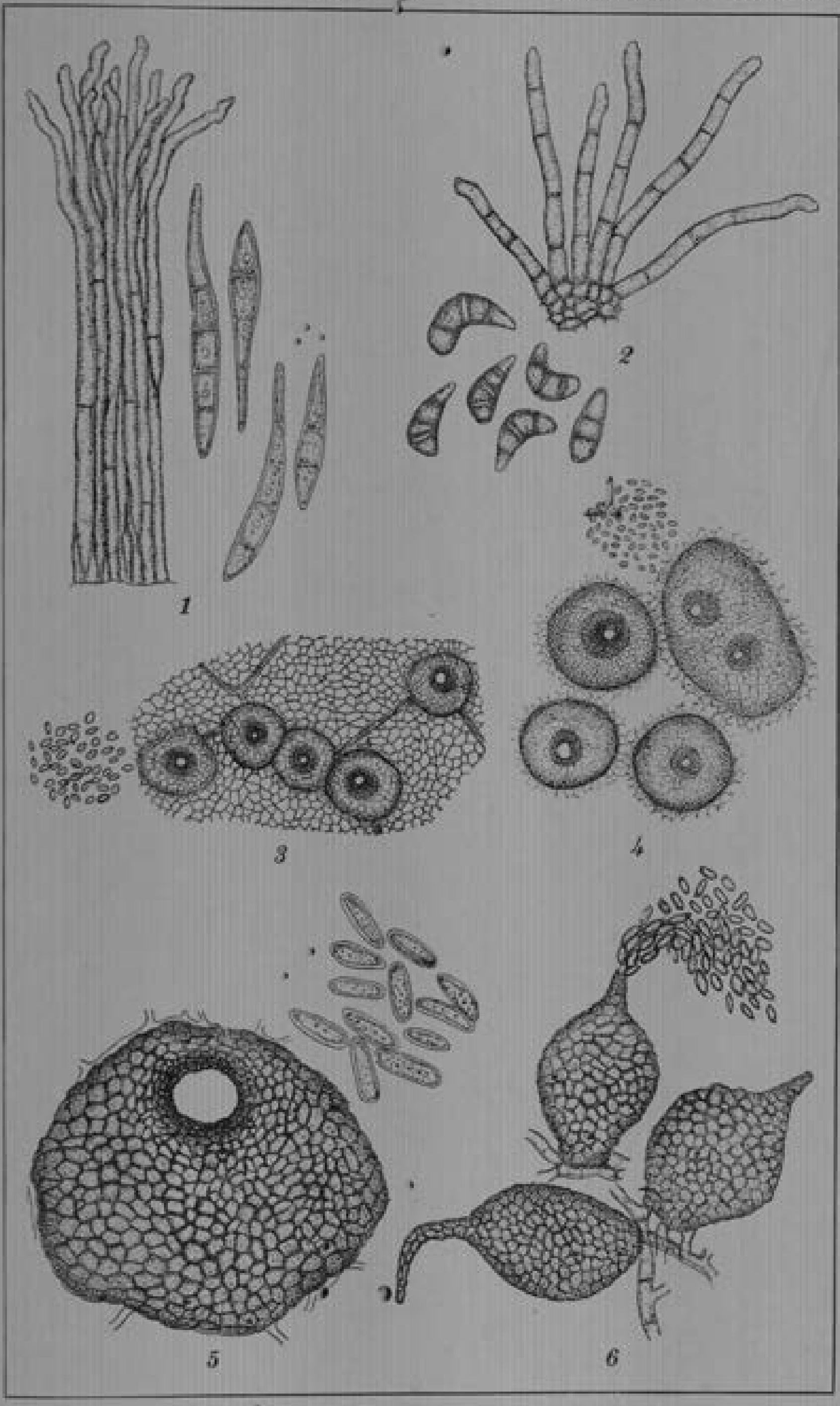

PLATE 4.

BIRDS FROM LEYTE

By Dioscoro S. Rabor
Of the Fish and Game Administration, Bureau of Science, Manila

INTRODUCTION

Information with regard to the avifauna of the Philippines is in many respects still meager or entirely lacking. Very little has been done in the study of bird distribution, local bird migrations, breeding and feeding habits, and other aspects of related nature.

Extensive collecting of birds in the various parts of the archipelago, notably in those localities which are still insufficiently worked out, will help much in the clearing up of these aspects. To this end, in May, 1937, the writer, together with an assistant, Manuel Celestino, made a collecting and observation trip in Leyte.

Leyte has been visited by few collectors, and its avifauna has not been studied as extensively as that of the contiguous island, Samar. Yet the locality has been and still is a rich field for the collecting of birds.

The earliest work on the birds of Leyte was done by Tweeddale (1878) on a collection made by Everett in 1877 in Amparo, on the southwest coast of the island. Of the 67 species he recorded, 1, *Arachnothera flammifera*, was described as new.

Ten years later the Steere Expedition visited the island, and J. B. Steere (1890) added many interesting species to the known avifauna of the locality.

John Whitehead (1896) made the third important collection in the island. He collected in the highlands of the northern part for three weeks, and then left the island due to unfavorable conditions for collection. Ogilvie-Grant (1897), working on Whitehead's Samar-Leyte collections, reported 14 species new to Leyte.

The Fleming Museum in Toronto[1] possesses a collection of birds made by Engineer J. J. Mounsey in the Philippines in 1909–10, and some of these birds are from Leyte. Nothing has been published on this collection.

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[1] Hachisuka (1931) 48.

In 1932 Andres Celestino, in connection with the studies on bird parasites conducted by Dr. Marcos Tubangui, of the Bureau of Science, made a collection in the vicinity of Palo, along the northeast coast of Leyte.

The present paper sets forth the results of recent collections and observations made by M. Celestino and the writer in the highlands of this island.

Helosig, a barrio nestling among the central highlands in the southern third of Leyte, was chosen as the best collecting site. The elevation of the site and its immediate vicinities varies from 750 to 1,250 meters above sea level. The barrio is approximately midway between Baybay (west coast) and Abuyog (east coast), so that collecting and observations were also carried on at several points between these two municipalities, along the newly constructed Baybay-Abuyog road. However, collecting and observations centered mainly in Helosig and its immediate vicinity including Maitum, Nebga, Magtarao, Maangnol, Himayangan, Tagabaca, Balinsasayao, and Quarry.

The present collecting site is practically untouched virgin forest, except for the small new clearings immediately adjacent to the highway. Towards the coast are small patches of coconuts, although in general these patches cannot be found at really high elevations.

The birds collected, together with notes and observations on their habits, are given below.

The nomenclature adopted is based mainly on the following sources: Peters, J. L., Birds of the World, 2 volumes; Hachisuka, M., Birds of the Philippine Islands, 4 parts; Kuroda, N., Birds of the Island of Java, 2 volumes; Chasen, F. N., A Handlist of Malaysian Birds; McGregor, R. C., A Manual of Philippine Birds.

BIRDS COLLECTED IN LEYTE

GALLUS GALLUS GALLUS (Linnaeus).

One adult male, 1 young male, and 1 female.

The juvenile specimen, almost a fledgeling, can hardly be distinguished from a domestic individual of the same age and plumage pattern. It flew about 50 meters, dodging among the tree trunks, and alighted on a branch about 7 meters from the ground.

The species is recorded for the first time from this locality.

The native name is *manok ihalas.*

TRERON POMPADORA AXILLARIS Bonaparte.

Two males and 3 females.

This species was observed feeding in flock on fruiting balete (*Ficus* sp.), together with other pigeons, as *Phapitreron amethystina amethystina*, *Phapitreron leucotis albifrons*, *Leucotreron occipitalis occipitalis*, and *Zonophaps poliocephala poliocephala*. Local hunters informed the writer that the species can be found in the mountain vicinities only from the latter part of May to September. During the other months of the year it goes to the lowlands.

The Philippine green pigeon is recorded for the first time from this island.

The native name is *punay*.

PHAPITRERON AMETHYSTINA AMETHYSTINA Bonaparte.

Ten males.

The specimens do not appreciably differ from the typical *P. a. amethystina* from Luzon. The measurements of an exceptionally large male are: Length, 313 millimeters; wing, 145; tail, 118; culmen, 26; tarsus, 19; middle toe with claw, 21.

In the forest the notes of the species are easily mistaken for the sound of a distant automobile horn.

The native name is *buro-buro*.

PHAPITRERON LEUCOTIS ALBIFRONS McGregor.

Eleven males and 12 females.

Measurements: Length, 250 millimeters; wing, 122; tail, 94; culmen, 18; tarsus, 21; middle toe with claw, 23.

A fine series of specimens of this species was secured, not differing appreciably from the typical *P. l. albifrons* from Bohol and Samar. McGregor (1909) and Hachisuka (1932) recorded the Leyte specimens as *P. l. brevirostris*. Manuel,[2] in the absence of specimens from Leyte, conjectured that the Leyte birds might be *P. l. albifrons*.

The species was commonly met with in both deep forest and second growth in the highlands and in the plains.

The native name is *limucon*.

LEUCOTRERON OCCIPITALIS OCCIPITALIS (Gray).

Five males and 4 females.

No difference exists between typical *L. o. occipitalis* from Luzon and Mindanao and the present specimens.

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[2] A review of Philippine pigeons. I. The genus Phapitreron. Philip. Journ. Sci. 56 (1936) 295.

The yellow-breasted fruit pigeon was very common in the highlands. Its notes closely resemble those of its congener, *L. l. leclancheri*.

The native name is *punay*.

DUCULA ÆNEA GLAUCOCAUDA Manuel.

One female.

Measurements: Length, 400 millimeters; wing, 240; tail, 159; culmen, 25; tarsus, 29; middle toe with claw, 50.

Grant (1878) identified the Leyte form as *Carpophaga ænea* (= *Muscadivores chalybura*). Recently Manuel,[3] reviewing the Philippine forms of Duculinæ, identified the Samar form as *Ducula ænea glaucocauda*. The powdery wash on the rectrices, primaries, and secondaries is very distinct in the present specimen.

The powdery-tailed imperial pigeon was observed singly on the outskirts of forests and in second growth in the highlands. Local hunters told the writer that the species begins to come to the highlands during the latter part of May and becomes abundant in about June and July. By September it disappears from the vicinity. Undoubtedly, like *Treron pompadora axillaris*, it stays in the lowlands during the other months of the year.

The native name is *balud*.

ZONOPHAPS POLIOCEPHALA POLIOCEPHALA (Gray).

Ten males and 7 females.

Measurements: Length, 410 millimeters; wing, 209; tail, 146; culmen, 23; tarsus, 26; middle toe with claw, 48.

A nice series of this beautiful pigeon, consisting of 17 specimens of both sexes, was secured.

Hachisuka[4] recognizes 2 races of this species: *Z. p. poliocephala* for the birds from Cebu, Leyte, Luzon, Mindoro, and Panay, and *Z. p. nobilis* from Basilan, Dinagat, Masbate, Mindanao, Negros, Samar, Sibuyan, and Tawitawi. Of the newly created race he writes, "this species resembles the typical *poliocephala*, but differs in having rich metallic-bronze reflections on the neck, back and wing coverts."

The individuals in the series present no appreciable difference from typical *poliocephala* from Luzon and Mindoro; nor do they show any difference from specimens of the supposed *nobilis* of Hachisuka collected from Basilan, Mindanao, Negros, and Sibuyan. The intensity of the coppery or bronze sheen in the plumage of the back presents a graduated series, varying a great deal in different specimens. Two specimens exhibited very distinctly the characteristic rich metallic bronze reflections on the neck, back, and wing coverts, a character which Hachisuka uses as a criterion for separating the South Philippine birds, as *nobilis*, from the rest. This character becomes doubtful as a basis for the formation of a new race after having been proven to be manifested in varying degrees by birds from Leyte that ought to be typical *Z. p. poliocephala*.

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[3] A review of Philippine pigeons, IV. Subfamily Duculinæ. Philip. Journ. Sci. 60 (1936) 410–412.

[4] Birds of the Philippine Islands 1 pt. 2 (1932) 199, 200.

The species was exceptionally common in the highlands. Not infrequently as many as two dozen birds were flushed in one feeding tree at one time, feeding in company with other species of pigeons. Only in this highland site was the species observed to form rather large feeding groups.

The native name is *hagum-hum* or *agum-um*.

MACROPYGIA PHASIANELLA TENUIROSTRIS Bonaparte.

One male.

The single specimen secured was taken in the foothills near the east coast in the vicinity of Balinsasayao River. Several specimens were observed in flight in the highlands.

CALLICOLUMBA CRINIGER (Jacquinot & Pucheran).

One male.

Measurements: Length, 278 millimeters; wing, 150; tail, 98; culmen, 17; tarsus, 34; middle toe with claw, 34.

The species was very rare in the highland vicinities. The single specimen secured was flushed from the same place for two consecutive days and was taken at last on the third day, on a high ridge thickly covered with tall trees, part of a dense forest in the vicinity.

GALLINULA CHLOROPUS LOZANOI Lletget.

One female.

The moorhen was commonly seen in the small ponds that dotted the plains and the foothills near the east coast.

The native name is *itumon*.

CHARADRIUS DUBIUS DUBIUS Scopoli.

Three males.

The little ringed plover was often met with in the sandy strips of the shallow Balinsasayao River, about 10 kilometers from the coast.

ACTITIS HYPOLEUCOS (Linnaeus).

One male.

The common sandpiper was secured in the same locality as the preceding species.

The species is recorded for the first time from the locality.

EGRETTA GARZETTA NIGRIPES (Temminck).

One female.

The little white egret was occasionally seen wading in the shallows of Balinsasayao River near the foothills.

The native name is *tabong*.

IXOBRYCHUS CINNAMOMEUS (Gmelin).

One female.

Several cinnamon bitterns were flushed from the tall grasses along the bank of Balinsasayao River, about 10 kilometers inland.

ACCIPITER TRIVIRGATUS TRIVIRGATUS (Temminck).

One male and 1 female.

Both specimens of the crested goshawk were secured in the highland forests near the roadside.

SPILORNIS HOLOSPILUS HOLOSPILUS (Vigors).

One male and 1 female.

Several Philippine serpent eagles were seen in the vicinity of clearings and along the roadside, usually perching on low branches of forest trees.

The native name is *sicub* or *sicup*.

HALIASTUR INDUS INTERMEDIUS Gurney.

One female.

A pair of Malayan brahminy kites were in the habit of perching on a high tree near the camp site. They preyed on the poultry in the neighborhood, and the farmers insistently requested us to shoot them. The female was taken, but the male deserted the vicinity.

The native name is *banog*.

PERNIS APIVORUS PTILORHYNCUS (Temminck).

One male.

The crested honey buzzard was rare in the vicinity. Only the specimen in the present collection was seen.

The species is recorded for the first time from the locality.

MICROHIERAX ERYTHROGENYS ERYTHROGENYS (Vigors).

One male.

Measurements: Length, 172 millimeters; wing, 110; tail, 69; culmen, 13; tarsus, 22; middle toe with claw, 22.

Comparison in measurements of the present specimen with *erythrogenys* and *meridionalis* that are in the Bureau of Science proved the Leyte bird to be *erythrogenys.* A Biliran specimen (Cat. No. 7597) collected by McGregor and A. Celestino also proved to be *erythrogenys.* It is strange that birds from Leyte and Biliran usually prove distinct from those of nearby Samar.

Leyte is a new locality for the species.

PSEUDOTYNX PHILIPPENSIS MINDANENSIS Grant.

One male (immature).

Measurements: Length, 520 millimeters; wing, 275; tail, 200; culmen, 50; tarsus, 68; middle toe with claw, 73.

The general color of the upper parts is mummy brown to blackish brown, with light ochraceous buff margins to the individual feathers. The rectrices and quills are mummy brown, with buff markings. The specimen is rather immature and in imperfect plumage. It is much darker than the typical *P. p. philippensis*.

The specimen was secured at daytime, in deep forest where it was perching on a low branch in deep shade. The horns were very distinct when the bird was excited.

The horned owl was rare in the vicinity.

The species is recorded for the first time from Leyte.

The native name is *pongao.*

OTUS BAKKAMOENA EVERETTI (Tweeddale).

One male.

Measurements: Length, 204 millimeters; wing, 155; tail, 75; culmen, 18; tarsus, 30; middle toe with claw, 30.

The single specimen of Everett's screech owl was secured near the camp site one evening.

The native name is *mingok.*

The species is recorded for the first time from the locality.

NINOX PHILIPPENSIS Bonaparte.

One male (nestling) and 1 female.

A nestling of the Philippine hawk owl was brought to the camp by a farmer, who found it in the hole of a tree which he felled in his new clearing in the forest. The young individual stayed in the camp for about a week before it died. The characteristic distinct white spots on the outer webs of the newly-developing quills are clearly shown in the young specimen. The remaining part of the plumage is all down.

The native name is *mingok*.

PRIONITURUS DISCURUS DISCURUS (Vieillot).

Three males and 5 females.

The Philippine racket-tailed parrakeet was commonly nesting in the highlands. Nest holes are frequently seen on the trunk of tall forest trees, usually near or in clearings. As many as six couples nested in one trunk. Apparently the holes are spacious inside, for the birds were always observed to get in head first and later to turn inside with only the bill visible from the outside. Natives climb the nests with much difficulty in order to procure the young birds for pets. These birds are taught to talk.

The native name is *canauihan*.

TANYGNATHUS LUCIONENSIS LUCIONENSIS (Linnaeus).

One male and 2 females.

A pair were seen nesting in the trunk of a tall tree in a clearing in the same nesting site as the preceding species. The nest hole was very similar to that of *Prioniturus*. The natives climb the nestholes of this species also, and get the young parrots for house pets.

The native name is *picoy* or *perico*.

BOLBOPSITTACUS INTERMEDIUS Salvadori.

Three males and 2 females.

The intermediate guaiabero was often seen feeding on guava shrubs in the lower altitudes, mostly in clearings or in second growth. The bird is difficult to distinguish from the leaves of the plants where it happens to perch, although it may give forth its whistling note all the while.

The native name is *koligot*.

LORICULUS PHILIPPENSIS WORCESTERI Steere.

Three males and 3 females.

Worcester's colasisi was commonly observed in the lower places of the vicinity, in both second growth and deep forest. It prefers the same type of habitat as the preceding species.

The native name is *kolansi* or *kolilising*.

BATRACHOSTOMUS SEPTIMUS SEPTIMUS Tweeddale.

One male.

Measurements: Length, 258 millimeters; wing, 160; tail, 127; culmen from base, 28; width of bill at gape, 41; tarsus, 18; middle toe with claw, 24.

The single specimen secured was one of a pair that Manuel Celestino flushed from the floor of a deep forest near a big stump. He was not able to shoot at the birds the first time they were flushed, for they suddenly disappeared in the thick growth around. He went back after two hours and flushed the pair again, from practically the same place as before. The male alighted on the nearby stump and was shot. The female disappeared in the thick growth around, and no amount of searching could flush it again. A search for the nest proved fruitless.

The present specimen very closely resembles a specimen of the same species in the Bureau of Science collection which was collected by McGregor and his party in Locquilocon, Wright, Samar.

The species was very rare in the locality.

Leyte is a new locality for the species.

EURYSTOMUS ORIENTALIS ORIENTALIS (Linnaeus).

Two males and 3 females.

The broad-billed roller was very common in the highlands. It was nesting in holes made high up in the sides of the trunks of dead or alive deep-forest trees left uncut in the clearings.

The native name is *salak*.

RAMPHALCYON CAPENSIS GIGANTEA (Walden).

Two males and 1 female.

The Philippine stork-billed kingfisher was occasionally seen in both highland and lowland streams.

The native name is *bakaka*.

CEYX FLUMENICOLA Steere.

Two males and 2 females.

Steere's river kingfisher was often met with, either flying low over the water in the highland creeks or perched on some branch in dark shaded places of small streams.

CEYX SAMARENSIS Steere.

One male.

Measurements: Length, 125 millimeters; wing, 60; tail, 26; culmen, 39; tarsus, 9; middle toe with claw, 16.

The present specimen closely resembles a specimen from Wright, Samar, collected by McGregor and his party, except that the bill of the typical *samarensis* (30 millimeters) is 9 millimeters shorter than in the present specimen.

This rare kingfisher was only seen once, and very accidentally, in the regions collected in. The single specimen secured alighted close to the writer who was seated while observing bird life in deep forest and whose presence did not seem to disturb it.

The native name for all kingfishers in the place is *bakaka*.

HYDROCORAX SEMICALEATUS (Tweeddale).

Six males, 3 adult females, and 3 young females.

The intermediate calao was very abundant in the highlands, where it was nesting during this month (May). Unlike its congener in Luzon and Mindanao, the Leyte form is not yet wary and permits close observation.

The native name is *cao*.

PENELOPIDES PANINI SAMARENSIS Steere.

Seven males and 5 females.

The Samar tarictic was abundant in the highlands.

The 7 males in the series present a great deal of variation in the size of the arrow-shaped black portion which Hachisuka[5] uses as an important criterion in differentiating the Leyte birds from those of Samar and Bohol. McGregor[6] considers the birds from the three above-mentioned localities as identical. Hachisuka[7] recognizes three distinct races of the birds in the above-mentioned localities: *P. p. samarensis* from Samar, having a broad black portion at the basal part of the tail feathers; *P. p. leytensis* from Leyte, "having small and more narrowly pointed black portion at the shaft of the tail feathers which is an intermediate character between *samarensis* and the bird from Bohol;" and *P. p. boholensis*, "having the tail feathers entirely rufous except the end, instead of having a portion of arrow shaped pattern at the basal part."

In the present series one male (rather immature) has the tail of the typical *P. p. samarensis* of Hachisuka[8] with the basal black portion almost occupying one third of the total length of the tail. On the extreme end of the series one male has the tail of the typical *boholensis* of Hachisuka in the total absence of the black portion from the base of the tail. Five individuals have the intermediate condition, ranging from almost no black portion to one with the tail almost resembling the typical *samarensis* of Hachisuka. The writer is of the opinion that this character varies with age and cannot be depended upon as a basis for racial subdivision.

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[5] Contributions to the Birds of the Philippines (2) pt. 6 (1930) 168, 169.

[6] A manual of Philippine Birds pts. 1, 2 (1909) 337.

[7] Contributions to the Birds of Philippines (2) pt. 6 (1930) 168, 169.

[8] Birds of the Philippine Islands 2 pt. 3 (1934) 161, text fig.

The native name is *taosi*.

LYNCORNIS MACROTIS MACROTIS (Vigors).

One male and 1 female.

Measurements: Male, length, 322 millimeters; wing, 254; tail, 179; culmen, 11; tarsus, 16; middle toe with claw, 27. Female, length, 324; wing, 272; tail, 172; culmen, 10; tarsus, 16; middle toe with claw, 27.

The plumage of the present specimens does not differ appreciably from that of typical Luzon and Mindanao birds.

Nightjars were occasionally observed in their crepuscular flights in the vicinity of the camp site. From their comparative size one could easily tell that two forms were found in the locality. The birds were within shooting distance and could have easily been hit, but the retrieving of the specimens presented difficulties. They always flew over densely vegetated areas, and it would have been impossible to find any bird that fell in the dense growth. However, one early evening a specimen was shot while crossing a cleared area. Another specimen flushed from its daylight bed in the forest floor was also secured.

The native name *kaó-kaó* is also given to *Caprimulgus*.

The species is recorded for the first time from the locality.

CAPRIMULGUS MACRURUS MANILENSIS Walden.

One male.

Measurements: Length, 243 millimeters; wing, 173; tail, 126; culmen, 9; tarsus, 16; middle toe with claw, 23.

The single specimen secured is in poor condition due to the rains. Comparison with specimens in the collection identified it as *C. macrurus manillensis*.

The species is recorded for the first time from the locality.

HEMIPROCNE COMATA MAJOR (Hartert).

Two males and 2 females.

Measurements: Males, length, 163, 167 millimeters; wing, 135, 127; tail, 79, 75; culmen, 5, 5; tarsus, 6, 6; middle toe with claw, 11, 11. Females, length, 167, 145; wing, 136, 125; tail, 83, 75; culmen, 5, 5; tarsus, 7, 6; middle toe with claw, 11, 11.

The present specimens do not appreciably differ from typical specimens of *H. c. major*, from Luzon, Mindoro, and Negros, nor from birds collected in Basilan and Mindanao. Hachisuka[9] recognizes three races of the species: *H. c. major*, *H. c. nakamurai*, and *H. c. comata*. He places the Basilan and Mindanao birds as a distinct race, *nakamurai*, differentiating them from the northern specimen by the supposedly stronger tinge of green on the back and under surface of the body, and by the measurements being intermediate between those of *major* and *comata*. The writer is of the opinion that examination of a large series of birds from the northern islands, Mindanao and Basilan, will prove *nakamurai* identical with *major*.

The species was commonly met with in the highlands.

It is recorded for the first time from the locality.

MEARNSIA PICINA (Tweeddale).

One male and 1 female.

Measurements: Male, wing, 170 millimeters; tail, 33; culmen, 5; tarsus, 10; middle toe with claw, 14. Female, wing, 177; tail, 34; culmen, 5; tarsus, 10; middle toe with claw, 14.

Tweeddale's spine-tailed swift is one of the rarest birds. Hachisuka[10] writes of this species ". . . *Chaetura picina* rarest of rare birds . . . Altogether only nine specimens of this genus are recorded."

Many big swifts were seen flying around the camp site, but always beyond shotgun range. One rainy day one of them was luckily brought down, and proved to be of the present species. The next day another was added to the collection.

The species is not rare in the highland regions collected in, scores of them being visible in high flight at any time of day; securing them, however, is quite difficult.

HARPACTES ARDENS (Temminck).

One male and 2 females.

This beautiful bird was frequently seen in the deep forests of the highlands.

SURNICULUS LUGUBRIS VELUTINUS Sharpe.

One male.

Measurements: Length, 208 millimeters; wing, 118; tail, 110; culmen, 20; tarsus, 16; middle toe with claw, 20.

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[9] Tom. cit., 172, 173.

[10] Birds from the Philippine Islands 1 pt. 1 (1931) 24; 2 pt. 3 (1934) 187.

The Philippine drongo cuckoo was rare in the highlands. The single specimen secured was shot in a thick growth bordering a new clearing.

The species has never before been recorded from Leyte.

HIEROCOCCYX SPARVERIOIDES (Vigors).

One female.

Measurements: Length, 322 millimeters; wing, 190; tail, 162; culmen, 30; tarsus, 20; middle toe with claw, 30.

The present specimen is indistinguishable from the typical *H. sparverioides* in the collection.

The Asiatic hawk cuckoo was very rare in the locality. The single specimen secured was the only individual seen in the site.

The species has been recorded only from Calamianes, Luzon, and Negros.

Leyte is a new locality for it.

CUCULUS CANORUS TELEPHONUS Cabanis and Heine.

One female.

Measurements: Length, 320 millimeters; wing, 207; tail, 168; culmen, 23; tarsus, 17; middle toe with claw, 28.

Like the preceding species, the European cuckoo has been recorded only from a few localities—Basilan, Batan, Calayan, Palawan, and Siquijor.

It was very rare in the highland regions covered.

It is recorded for the first time from Leyte.

CENTROPUS VIRIDIS (Scopoli).

One male.

The red-winged coucal was not seen at all in the highlands. However, it was common in the second growth of the foothills and the lowlands.

The native name is *ko-kok*.

CENTROPUS MELANOPS Lesson.

Two males.

The black-eyed coucal was often met with in the highlands, usually in thick growth near or in clearings.

The native name is *abunog*.

CHRYSOCOLAPTES LUCIDUS RUFOPUNCTATUS Hargitt.

Three males and 6 females.

The red-spotted golden flicker was often seen on the outskirts of deep forests which bordered clearings. It was also occasionally seen in deep woods.

The native name is *bala-latok* or *batok,* a name also given to the other species of woodpecker.

LICHTENSTEINIPICUS FULIGINOSUS (Tweeddale).

Two males and 1 female.

The sooty woodpecker was seldom met with in the highlands. All the three specimens secured were collected in very deep forest far from clearings.

THRIPONAX PECTORALIS Tweeddale.

Six males and 4 females.

This species was commonly found in both deep forest and clearings. Three individuals were observed feeding on an ant colony in a dead trunk in a clearing.

SARCOPHANOPS SAMARENSIS Steere.

Two males and 1 female.

Measurements: Males, length, 145, 150 millimeters; wing, 77, 78; tail, 54, 55; culmen, 20, 20; tarsus, 20, 21; middle toe with claw, 21, 21. Female, length, 149; wing, 77; tail, 56; culmen, 20; tarsus, 20; middle toe with claw, 21.

The Leyte specimens are indistinguishable from typical *S. samarensis* of Samar. The species is rare in the highlands. Five individuals, apparently belonging to one feeding group, were seen in deep forest; three of them were secured while the others disappeared in the thick growth.

HYPOTHYMIS AZUREA AZUREA (Boddaert).

One male.

The black-naped flycatcher was commonly met with in second growth and occasionally in the forest.

RHIPIDURA SUPERCILIARIS SAMARENSIS (Steere).

Two males and 1 female.

The Samar blue fantail flycatcher was often met with in company in thick growth in the forest.

RHINOMYIAS RUFICAUDA MINDANENSIS Mearns.

One male.

Measurements: Length, 145 millimeters; wing, 81; tail, 66; culmen, 15; tarsus, 17; middle toe with claw, 17.

The present specimen is indistinguishable from typical *R. r. mindanensis* from Mindanao. It is appreciably bigger than any of the *R. r. samarensis* in the collection of the Bureau of Science from Samar. Hachisuka (1935) considers the Samar, Leyte, and Mindanao forms as belonging to one race, *R. r. samarensis.*

The species is very rare in the highlands.

CORACINA STRIATA KOCHI (Kutter).

One male and 2 females.

Koch's barred cuckoo shrikes were frequently met with in tall trees in deep forest near clearings. Occasionally individuals invaded the clearings where they were easily secured.

IRENA ELLÆ Steere.

One male and 2 females.

Ella's fairy bluebirds were not scarce in the deep forests of the highlands, but they were often mistaken for *Dicrurus.*

IOLE EVERETTI (Tweeddale).

Three males and 2 females.

The species was commonly met with on the outskirts of deep forest and second growth, especially near river banks.

IOLE PHILIPPENSIS PHILIPPENSIS (Gmelin).

Two males and 1 female.

The Philippine bulbul was commonly observed in second growth and in clearings.

The native name is *paragó* or *palagó.*

PYCNONOTUS GOIAVIER GOIAVIER (Scopoli).

One male.

The guava bulbul was often seen in clearings and second growth, both in the highlands and in the lowlands.

The native name of this species also is *paragó* or *palagó.*

PTILOCICHLA MINUTA Bourns and Worcester.

One female.

Measurements: Length, 128 millimeters; wing, 64; tail, 42; culmen, 16; tarsus, 25; middle toe with claw, 21.

The present specimen is indistinguishable from typical *P. minuta* from Wright, Samar.

The lesser ground babbler is not at all rare in the highlands. Several specimens were seen in very thick undergrowth in deep forest, but they were very difficult to secure.

MACRONOUS STRIATICEPS MINDANENSIS Steere.

One male and 3 females.

The present specimens do not show any difference from typical *M. s. mindanensis* from Mindanao.

The Mindanao tit babbler was often seen in groups of several individuals on the forest floor, and in thick second growth.

ORTHOTOMUS FRONTALIS Sharpe.

One male and 1 female.

Sharpe's tailorbird was commonly seen and heard in thick growth around clearings.

MEGALURUS PALUSTRIS FORBESI Bangs.

One female.

The striated marsh warbler was never observed in the highlands, but it was common in the lowlands near the coast.

The species is recorded for the first time in Leyte.

ARTAMUS LEUCORHYNCHUS LEUCORHYNCHUS (Linnæus).

One female.

The white-bellied swallow shrike was rarely seen in the highlands, but was common in the lowlands.

The native name is *it-it*.

HYLOTERPE APOENSIS Mearns.

One female.

This thickhead was scarce in the highlands. Only the single specimen secured was seen. It was taken in deep forest.

CALLISITTA FRONTALIS LILACEA (Whitehead).

One female.

The lilac-faced nuthatch was seen but once in the highlands. A pair was seen climbing round and round the trunk of a very tall forest tree in deep forest, well beyond gun range. The female luckily moved to a lower perch and was secured.

ZOSTEROPS PALPEBROSA BASILANICA Steere.

Three females.

Steere's silvereye was often met with in small groups in second growth.

DICÆUM CINEREIGULARE Tweeddale.

Three males.

The ashy-chinned flowerpecker was common in second growth and in the standing vegetation of clearings.

DICÆUM EVERETTI Tweeddale.

One male.

Measurements: Length, 82 millimeters; wing, 50; tail, 28; culmen, 12; tarsus, 12; middle toe with claw, 14.

Everett's flowerpecker was met with only once in the highlands, feeding on a low fruiting tree in deep forest in company with *Prionochilus inexpectatus*.

PRIONOCHILUS OLIVACEUS Tweeddale.

One male.

Measurements: Length, 87 millimeters; wing, 53; tail, 28; culmen, 10; tarsus, 12; middle toe with claw, 13.

The present specimen is indistinguishable from typical *P. olivaceus* from Samar. The single specimen secured was seen feeding on a fruiting bush in deep forest together with several *P. inexpectatus*. Apparently the species is rare in the vicinity.

PRIONOCHILUS INEXPECTATUS Hartert.

Two males and 1 female.

Hartert's flowerpecker was rather common in the highlands.

ÆTHOPYGA BELLA Tweeddale.

Two males and 2 females.

Measurements: Length, 77 millimeters; wing, 40; tail, 30; culmen, 12; tarsus, 12; middle toe with claw, 12.

Tweeddale's sunbird was commonly seen in coconut groves in highland clearings, and in second growth.

Whitehead collected the species in Samar. It is recorded from Leyte for the first time.

EUDREPANIS PULCHERRIMA (Sharpe).

One male.

Measurements: Length, 78 millimeters; wing, 48; tail, 26; culmen, 18; tarsus, 14; middle toe with claw, 13.

The Mindanao sunbird was only seen once in the highlands, emerging from a thick bush by the roadside. Apparently it is rare in the highlands.

LEPTOCOMA BRAZILIANA SPERATA (Linnæus).

One male.

The red-breasted sunbird was common in coconut groves in the same vicinity as *Æthopyga bella*. Oftentimes these two specimens were seen feeding on coconut flowers on the same tree at the same time.

ANTHREPTES MALACCENSIS GRISEIGULARIS Tweeddale.

Two males and 3 females.

Measurements: Length, 104 millimeters; wing, 60; tail, 40; culmen, 16; tarsus, 15; middle toe with claw, 16.

The present specimens are indistinguishable from typical *A. m. griseigularis* from Samar.

The gray-throated sunbird was often observed in coconut groves, feeding on the insects attracted by the coconut flowers.

The species is recorded for the first time from Leyte.

ARACHNOTHERA PHILIPPINENSIS (Steere).

One female.

Measurements: Length, 150 millimeters; wing, 85; tail, 45; culmen, 38; tarsus, 18; middle toe with claw, 18.

The naked-faced spider hunter was seen only once in the highlands. The only specimen secured was shot in dark dense growth at the side of a creek.

UROLONCHA LEUCOGASTRA EVERETTI (Tweeddale).

One female.

Everett's weaver was commonly met with in flock, feeding on the patches of mountain rice in the highlands. The species was just as abundant in the highlands as the Philippine weaver, *Munia atricapilla minuta*.

The native name is *maya*.

ORIOLUS CHINENSIS CHINENSIS Linnæus.

One male and 1 female.

The Philippine oriole was a very common bird at low altitudes.

ORIOLUS XANTHONOTUS SAMARENSIS Steere.

One male.

Measurements: Length, 203 millimeters; wing, 118; tail, 87; culmen, 24; tarsus, 22; middle toe with claw, 22.

The Samar oriole was very rare in the vicinity. The single specimen secured was shot from a high forest tree by the roadside.

Whitehead (Grant, 1897) writes of the species, "This species, according to my experience, was extremely rare in both islands. . . ."

DICRURUS HOTTENTOTTUS STRIATUS Tweeddale.

Three males and 5 females.

The southern drongo was commonly met with in both deep forest and second growth. The native hunters believe that the bird invariably follows in the wake of feeding monkey groups. They believe in a very close relationship between the bird and the monkey.

The native name is *agad-agad* or *uwak-uwak*.

SARCOPS MELANONOTUS Grant.

One male and 1 female.

The black-backed coleto was very common in the highlands and in the lowlands near the hills.

The native name is *ding*.

Two hundred and fifty-seven specimens were collected, belonging to 77 forms, 17 being recorded for the first time from the locality.

The following species were observed in the highland vicinities but not collected: *Megapodius* sp., *Chalcophaps indica indica* Linnæus, *Rallus torquatus torquatus* Linnæus, *Poliolimnas cinereus* (Vieillot), *Collocalia* sp., *Pitta sordida sordida* (P. L. S. Müller), *Pericrocotus flammeus leytensis* Steere, and *Poliolophus urostictus urostictus* (Salvadori). Three of the forms observed, *Megapodius* sp., *Chalcophaps indica indica*, and *Pitta sordida sordida*, are recorded for the first time from the locality. A total of 20 forms will have been recorded as new to the locality if the 3 species which were observed but not collected be included.

The forms collected from Leyte have been recorded from Samar, except the following 6: *Pseudotyux philippensis mindanensis*, *Lyncornis macrotis macrotis*, *Caprimulgus macrurus manillensis*, *Mearnsia picina*, *Hierococcyx sparverioides*, and *Cuculus canorus*. In general the avifauna of Leyte and Samar is very similar.

SUMMARY AND CONCLUSIONS

In May, 1937, the writer, accompanied by Manuel Celestino, made a collection and observation of birds in Leyte, in order to obtain data which may aid in the solution of such important ornithological problems as bird distribution, local bird migrations, and breeding and feeding habits.

Collections and observations were carried on in the vicinity of Helosig, a highland barrio in the central highlands of the southern third of Leyte. Two hundred and fifty-seven specimens, belonging to 77 forms, were collected. Eight forms were observed but not collected. Seventeen forms of those collected, and 3 of those observed, are newly recorded from the locality.

All but 6 forms collected in Leyte have been recorded from Samar. In general there is a very close relationship between the avifauna of Leyte and that of Samar.

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FIVE OTHER KNOWN SPECIES OF PENÆUS IN THE PHILIPPINES

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FOUR PLATES

Blanco and Arriola (1937) were the first to attempt a systematic study of some known species of Philippine Penæidæ in a single paper. They described five species, *Penæus canaliculatus* Olivier, *Penæus affinis* Milne-Edwards, *Penæus incisipes* Spence Bate, *Penæus indicus* Milne-Edwards, and *Penæus monodon* Fabricius. Five other species are of economic importance; namely, *Penæus indicus* var. *longirostris* de Man, *Penæus canaliculatus* var. *japonicus* Spence Bate, *Penæus anchoralis* Spence Bate, *Penæus monodon* var. *manillensis* var. nov., and *Penæus rectacutus* Spence Bate. These have not heretofore been reported or described from the Philippines. *Penæus monodon* is locally known as *sugpo,* and all the other species as *hipon suahe.* The present study brings the systematics of Philippine shrimps of the genus *Penæus* up to date, and also gives the taxonomy and morphology of these crustaceans.

The body of a *Penæus* may be divided into two general parts, the cephalothorax and the abdomen. The cephalothorax represents a fusion of the head and thorax, and is covered dorsally and laterally by the carapace. Arising from the midanterior margin of the carapace is a straight rostrum, which is elevated dorsally but compressed laterally into a crest. It is armed dorsally with spines, ranging in number from 6 to 12, and ventrally with 0 to 5 spines $\left\{\frac{6-12}{0-5}\right\}$.

On either side of the carapace near the anterior margin are two teeth the anterior of which is the first antennal tooth, and the posterior, the hepatic tooth. At the anterior margin of the carapace, on each side of the base of the rostrum, is an eye mounted on a stalk. Below the eye is the hollow peduncle of the first antenna, which bears a bifurcate flagellum. Immediately beneath the peduncle is a scalelike structure, the antennal scale or scaphocerite of the second pair of antennæ. From the base of this scale at its ventral side arises the whiplike flagellum of the second antenna.

On the ventral side of the cephalothorax are five pairs of legs, the pereiopods. The first three pairs are provided with pincers. Each of these legs are made up of several segments, the ischiopodite, the carpopodite, and the propodite, the latter giving rise to the immobile finger of the pincers. The other part of the pincer is movable, and is known as the mobile finger. The last two pairs of pereiopods do not possess pincers, but have the dactylopodites instead. All of these appendages are connected to the cephalothorax by two very short segments, the coxopodite and the protopodite.

The buccal cavity is bordered by the following oral appendages: A pair of mandibles; the first and second pairs of maxillæ; and the first, second, and third pairs of maxillipeds, which are in reality thoracic appendages performing functions of an oral appendage. At the mouth region are two other structures that might be mistaken for true limbs but which do not belong to the same category. At the anterior border of the buccal aperture is a much thickened upper lip, the labrum situated just in front of the well-developed mandibles. The lower lip, which has two lobes, the pragnatha, appearing like true appendages, adheres to the posterior surface of the mandibles.

The abdomen is made up of six ordinary segments and one terminal pointed telson grooved on its middorsal surface. All the abdominal somites are covered with a tough exoskeleton, the dorsal surface of each and part of the lateral sides of which are designated as the tergum, and the lower part of the lateral sides, the pleuron. Attached to the sides of each of the first five somites at the ventral surface of the abdomen is a pair of swimmerets or pleopods. The sixth somite possesses longer and broader appendages, the uropods, which together with the telson form the tail fan.

The male is differentiated from the female by the presence of the petasma, a membranous development of the endopodites of the first pair of its pleopods. The male genital opening is situated at the coxopodites of the fifth pair of pereiopods. The female, on the other hand, has its sternum divided longitudinally into a median cleft, immediately between the fifth pair of pereiopods. The sides of this cleft appear as flattened calcified plates, called the thelycum. This structure extends from the base of the coxopodites of the fourth pair of pereiopods to the posterior border of the sternum. The female genital opening is located on the coxopodites of the third pair of pereiopods. The exopodite of the first pair of pleopods is long and flat, while the endopodite is less developed, appearing like a small bud.

PENÆIDÆ

Body laterally compressed. Carapace well developed, passing beneath anterior border of coxal plates of first segment of abdomen. Rostrum usually long, laterally compressed, and mostly strengthened on sides by a longitudinal ridge; teeth generally numerous. Antennules with two flagella. Mandible large and powerful with an incisive external margin, with palp of one or two segments. Five pairs of pereiopods present, first three pairs slender and chelate; last two pairs with dactylopodites.

Genus PENÆUS Fabricius

Body laterally compressed up to posteriormost somite. Carapace armed with a laterally compressed rostrum, more or less toothed or fringed with tiny hairs. Eyes large and ovate, supported by two-jointed stalks. Antennæ with two flagella shorter than carapace. Antennules with a large scaphocerite toothed on its outer margin, foliaceous and thin on inner margin. Mandibles large and strong, with large and foliaceous two-jointed palps. First three pairs of pereiopods chelate; last two pairs terminate in dactylopodites. Pleopods large, with two foliaceous branches in all pairs except first pair which exhibits characters for sexual dimorphism.

Key to the Philippine species of Penæus.

a^1. Lateral rostral sulci extending to posterior margin of carapace, ventral rostral tooth opposite anterior rostral tooth.

  b^1. Telson without spinules on lateral margin. Rostral formula $\frac{9-10-11}{1}$.

Penæus canaliculatus Olivier.

  b^2. Telson armed with three small spines on lateral margin. Rostral formula $\frac{11-12-13}{1}$ ....*Penæus canaliculatus* var. *japonicus* Spence Bate.

a^2. Lateral rostral sulci not extending to posterior margin of carapace, ventral rostral tooth either absent or present.

  b^1. Rostrum without crest, ventral margin without teeth.

    c^1. Telson without spines.

      d^1. Rostral formula $\frac{9-11}{0}$; rostrum slightly turned upward on tip.

Penæus affinis Milne-Edwards.

d^1. Rostral formula $\frac{8-9-10-11}{0}$; rostrum narrow and straight.
Penæus incisipes Spence Bate.

c^2. Telson with spines.

d^1. Rostral formula $\frac{8-10}{0}$; 1 tooth on gastric region. Telson armed with one small spine on lateral margin.
Penæus anchoralis Spence Bate.

d^2. Rostral formula $\frac{9}{0}$; one tooth on gastric region. Telson armed with two small spines on lateral margin.
Penæus rectacutus Spence Bate.

b^2. Rostrum with crest.

c^1. Ventral margin with teeth.

d^1. Rostrum distinctly curved upward. Rostral formula $\frac{7-8}{5}$. Rostrum projects beyond antennal scales by one-third to two-fifths of free portion.... *Penæus indicus* var. *longirostris* de Man.

d^2. Rostrum straight.

e^1. Rostral formula $\frac{7-8}{4-5}$........ ....*Penæus indicus* Milne-Edwards.

e^2. Rostral formula $\frac{6-7}{3}$........................*Penæus monodon* Fabricius.

c^2. Ventral margin without teeth. Rostrum short, extending as far as middle of second joint of antennal peduncle. Rostral formula $\frac{6}{0}$.............................. *Penæus monodon* var. *manillensis* var. nov.

PENÆUS CANALICULATUS var. JAPONICUS Spence Bate. Plate 1, figs. 1, 2, 4, and 5.

Penæus canaliculatus var. *japonicus* SPENCE BATE, Challenger Report, Macrura (1888) 245, pls. 31, 32, 37; ALCOCK, Ann. & Mag. Nat. Hist. 14 (1905) 514.

Penæus canaliculatus ORTMANN, Zool. Jahrb. Abth. f. Syst. 5 (1890) 448, pl. 36, figs. 2a, b[1]; KISHINOUYE, Journ. Fish. Bur. 8 (1) (1900) 6, 11, pls. 1, 7, figs. 1, 1a–c; RATHBUN, Proc. U. S. Nat. Mus. 26 (1902) 37; ALCOCK, Cat. Indian Decap. Crust. pt. 3, Macrura, Fasc. 1 (1906) 14, pl. 2, figs. 6a–c.

Penæus japonicus NOBILI, Annal. Science Natur. IX 4 (1906) 10; DE MAN, Decapoda Siboga Exped. pt. 1 (1911) 107.

Rostrum as long as penultimate joint of antennular peduncle. Rostral formula $\frac{12}{1}$, all teeth lined with hairs. Five teeth on carapace. Postrostral carina longitudinally grooved. Lateral grooves very distinct, extending to posterior border of carapace. Two last segments of abdomen laterally compressed and dorsally keeled. Posterior end of sixth somite toothed. Telson armed with three small spines on lateral margin, dorsally grooved and apex acuminate.

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[1] Not in Scientific Library, Philippine Bureau of Science.

Description based on a female specimen, 111 millimeters long from anterior border of carapace to posterior end of telson.

Eighteen specimens, 56 to 111 millimeters long.

Locality.—Manila Bay (*G. A. Lopez*); BANTAYAN, Cebu Province, Bantayan (*G. A. Lopez*).

PENÆUS INDICUS var. LONGIROSTRIS de Man. Plate 2, fig. 1.

Peneus indicus var. *longirostris* DE MAN, Siboga Exped. Decapoda 55 pt. 1 (1911) 103–4; ALCOCK, Cat. Indian Decap. Crust. pt. 3, Macrura, Fasc. 1 (1906) 12.

Rostrum curved upward, projecting $\frac{1}{3}$ of free portion beyond antennal scales. Rostral formula $\frac{7}{5}$. Three teeth present on carapace. Rostral crest typical. Grooves on either side of rostrum ending besides first epigastric tooth. Telson acuminate, dorsally grooved, lateral sides fringed with hairs.

Description based on a male specimen 93 millimeters long, from anterior border of carapace to posterior end of telson.

Seven specimens 65 to 121 millimeters long.

Locality.—Manila Bay (*Aldaba and Talavera*); PANAY, Iloilo Province, La Paz (*Mendoza*); NEGROS, Oriental Negros Province, Ibanhay.

PENÆUS ANCHORALIS Spence Bate. Plate 3, fig. 2.

Penæus anchoralis SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 258, pl. 35, fig. 1.

Rostrum without crest, ventral margin without teeth. Rostral formula $\frac{8-10}{0}$; one tooth on gastric region. Third and succeeding segments of abdomen carinated, sixth ending in a small tooth. Telson longitudinally grooved and pointed, armed with one small spine on lateral margin.

Description based on a female specimen 81 millimeters long from anterior border of carapace to posterior end of telson.

Locality.—Manila Bay (*A. Seale*).

PENÆUS MONODON var. MANILLENSIS var. nov. Plate 3, fig. 1.

Rostrum with crest, ventral margin without teeth. Rostral formula $\frac{6}{0}$. Last two segments of abdomen carinated. Telson longitudinally grooved, lateral margin fringed with hairs.

This variety differs from the type species in the following points: (*a*) Dorsal surface of rostrum armed with 6 spines, the two anteriormost minute; ventral surface smooth; (*b*) rostrum short, reaching as far as middle of second joint of antennal peduncle.

Description based on a female specimen 195 millimeters long from anterior border of carapace to posterior end of telson.

Type variety bears accession number 200, Fish and Game Administration, Bureau of Science.

Locality.—Manila Bay.

PENÆUS RECTACUTUS Spence Bate. Plate 2, fig. 3.

Penæus rectacutus SPENCE BATE, Rept. Voy. Challenger, Zoöl. 24 (1873–76) 266, pl. 36, fig. 2.

Metapenæus rectacutus ALCOCK and HENDERSON, Journ. Asiat. Soc. Bengal 63 (1894) 145.

Parapenæus rectacutus DE MAN, Decapoda, Siboga Exped. 55 (1911) 82; BALSS, Macrura, Deutsche Tiefsee Exped. 2 (1925) 228.

Rostrum horizontal, straight and pointed. Ventral margin hairy. Rostral formula $\frac{9}{0}$; one tooth on gastric region. Posterior end of fourth and fifth somites slightly cleft on median line. Sixth somite twice the length of the fifth and ending in a small tooth. Telson with two small spines on each side.

Description based on a female specimen 65 millimeters long from anterior border of carapace to posterior end of telson. It bears accession number 0-216, Zoölogy Department, University of the Philippines.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Penæus canaliculatus* var. *japonicus* Spence Bate; lateral view of head, natural size.

2. *Penæus canaliculatus* var. *japonicus* Spence Bate; dorsal view of telson and uropods, natural size.

3. *Penæus canaliculatus* Olivier; dorsal view of telson and uropods, natural size.

4. *Penæus canaliculatus* var. *japonicus* Spence Bate; ventral side of a male showing the petasma.

5. *Penæus canaliculatus* var. *japonicus* Spence Bate; ventral side of a female showing the thelycum.

PLATE 2

FIG. 1. *Penæus indicus* var. *longirostris* de Man; lateral view of head, natural size.

2. *Penæus indicus* Milne-Edwards; lateral view of head, natural size.

PLATE 3

FIG. 1. *Penæus monodon* var. *manillensis* var. nov., lateral view of head, natural size.

2. *Penæus anchoralis* Spence Bate; natural size.

3. *Penæus rectacutus* Spence Bate; natural size.

PLATE 4

Diagrammatic drawing of a *Penæus*. *ant*, Antennule; *sca*, scaphocerite; *a*, antenna; *e*, eye; *r*, rostrum; *c*, carapace; *ab*, abdomen; *s*, somite; *t*, telson; *u*, uropod; *pl*, pleopod; *pr*, pereiopod.

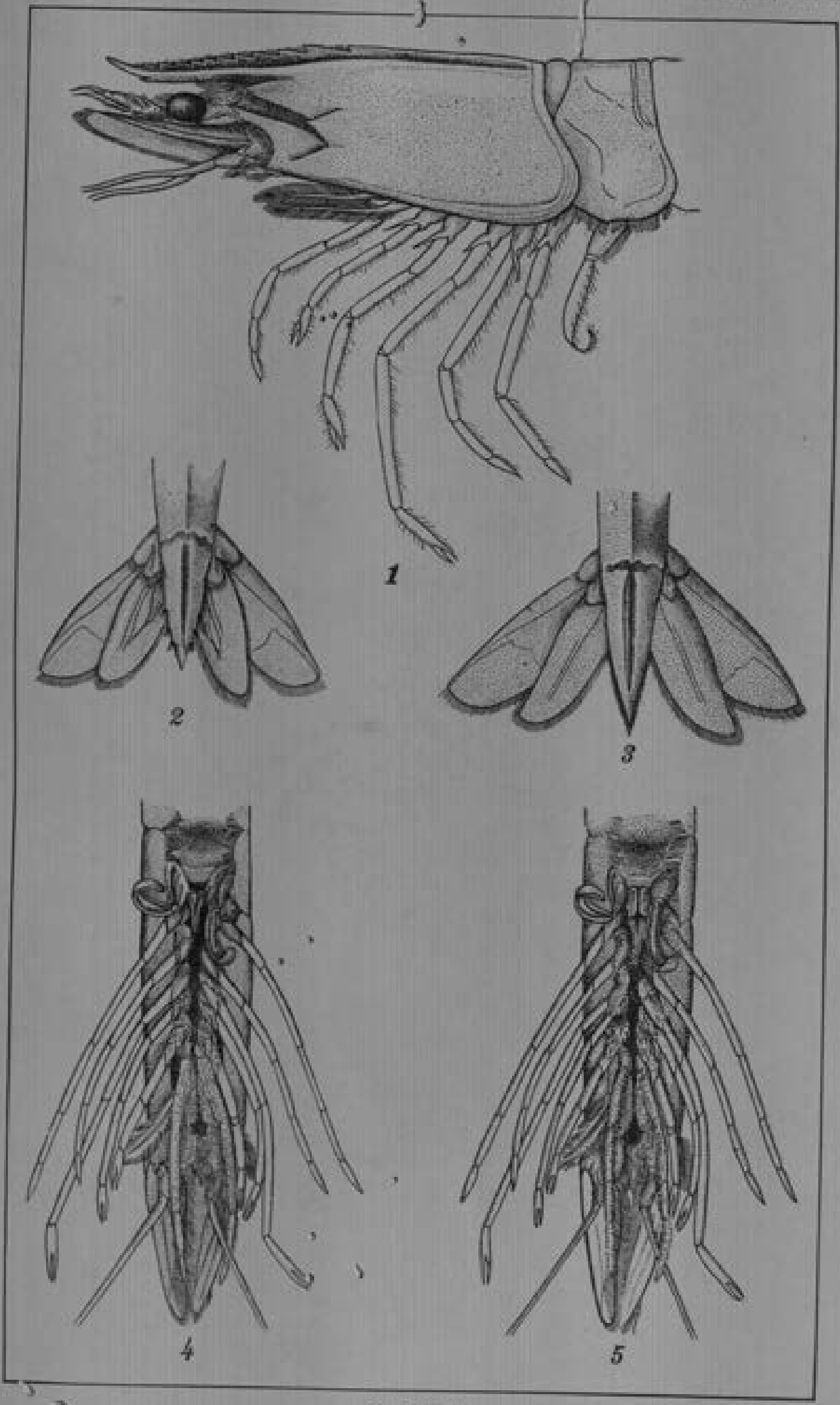
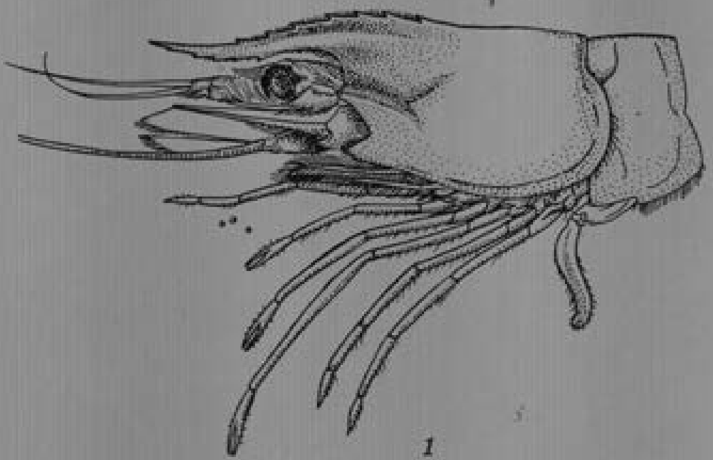


PLATE 1.



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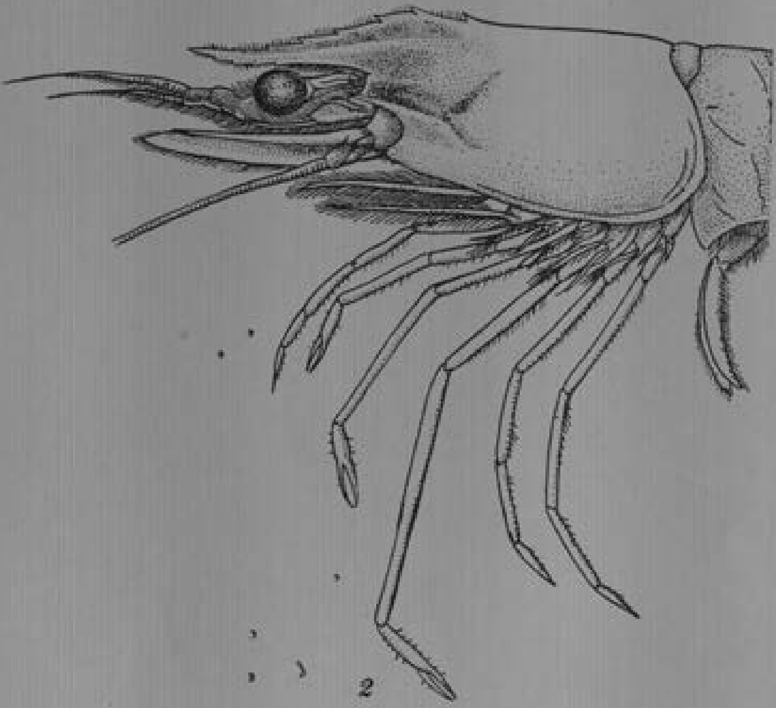

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PLATE 2.

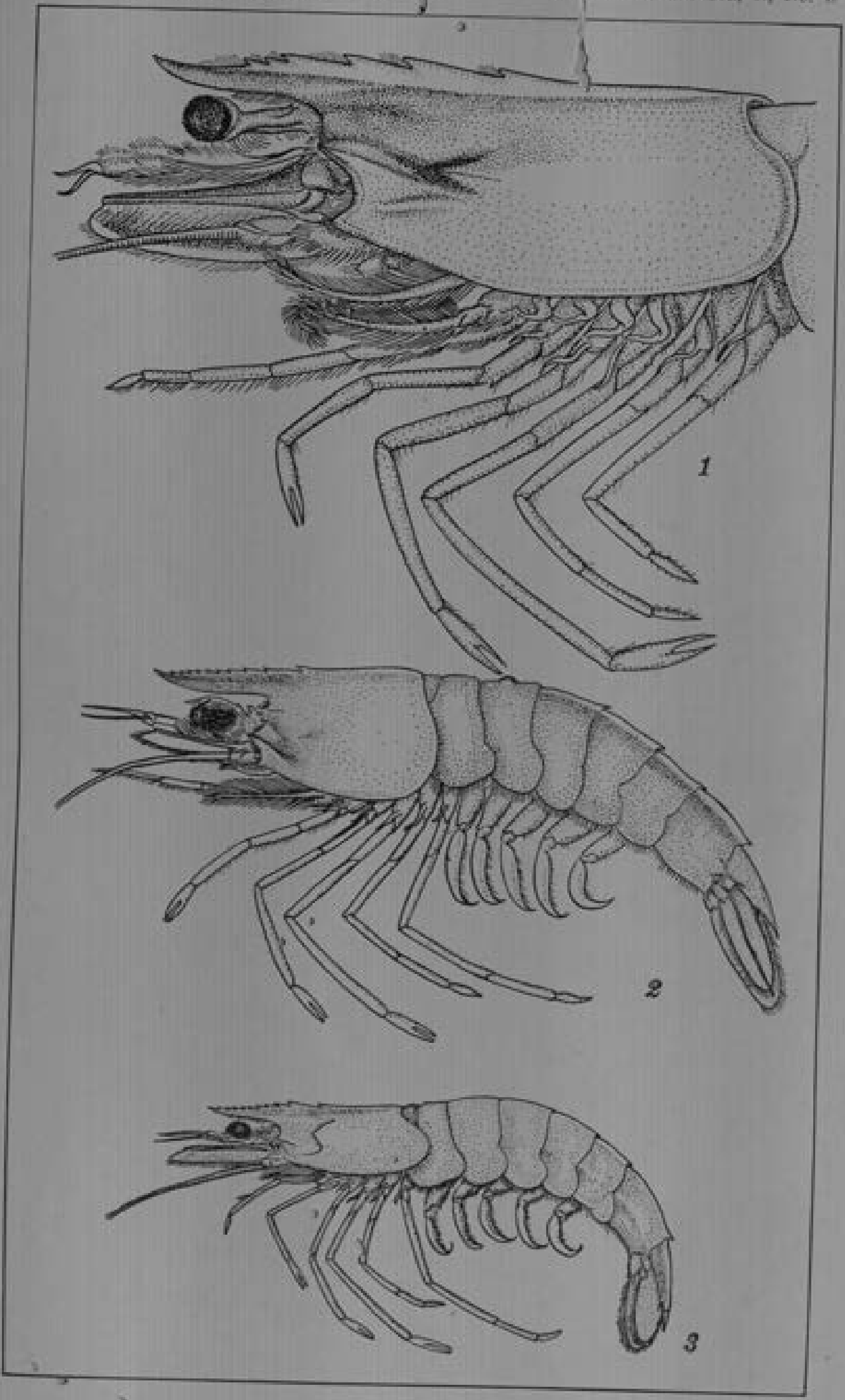

PLATE 3.

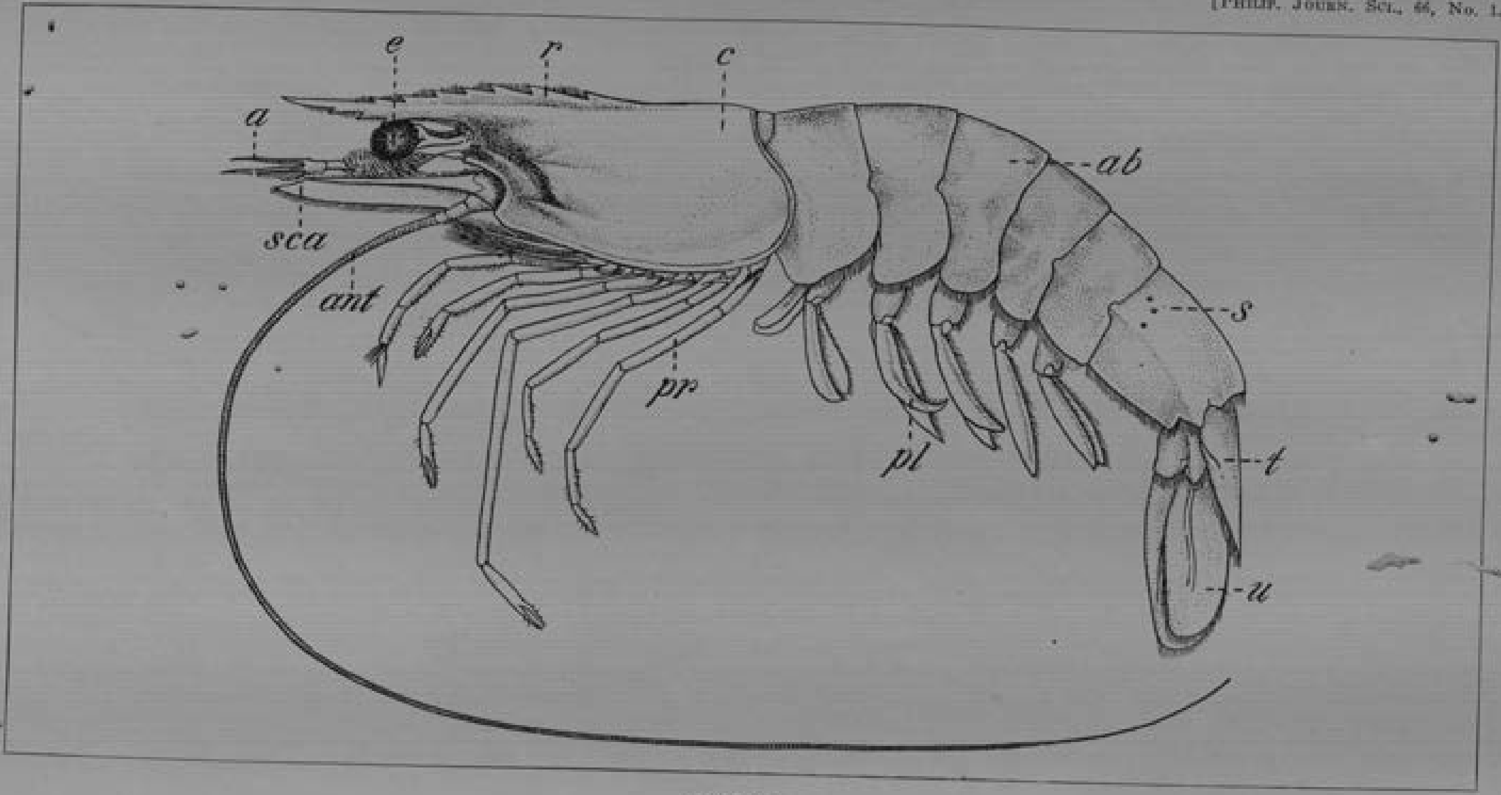

PLATE 4.

DIATOMS FROM ARGUN RIVER, HSING-AN-PEI PROVINCE, MANCHOUKUO

By B. W. Skvortzow
Of Harbin, Manchoukuo

TWO PLATES

The material reported in the following pages was collected by Mr. P. A. Pavlov, the enthusiastic collector of the former Manchuria Research Society of Harbin, in the summer of 1927 in the environs of the Chalainor station of the Chinese Eastern Railway, at the source of Argun River, which arises from Dalai-nor or Talaihu Lake. The collection consists of only one tube of specimens. Thanks are due to Mr. P. A. Pavlov for placing the material at my disposal.

Only one of my papers deals with the diatom flora of Dalai-nor Lake.[1] Another paper deals with diatoms from the Great Khingan mountains, east of Argun River.[2] A third deals with the diatom flora of the Hailar district.[3] The diatom flora of Argun River is quite rich, being represented by 163 different forms in the single sample examined. The following species predominate in the Argun collection:

Cyclotella Meneghiniana fo. *plana.*
Synedra ulna.
Caloneis silicula.
Neidium dubium and fo. *argunensis.*
Navicula cuspidata var. *ambigua.*
Navicula pupula var. *capitata* and var. *elliptica.*
Navicula protracta.
Cymbella cuspidata.
Nitzschia acicularis.

Of 163 different diatoms 137 were fresh-water species, and about 25 are also known in slightly brackish water. They are the following:

Caloneis silicula.
Anomoeoneis sphaerophora.
Navicula cruciculа var. *obtusata.*
Navicula cryptocephala var. *veneta.*
Navicula rhynchocephala var. *tenua.*
Navicula viridula and three varieties.
Navicula hungarica var. *linearis* and two other varieties.

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[1] Philip. Journ. Sci. 41 (1930) 31.
[2] Ibid. 35 (1928) 39.
[3] Hedwigia (1928).

Navicula lanceolata.
Navicula oblonga var. *subparallela.*
Amphora veneta.
Cymbella prostrata.
Epithemia turgida.
Epithemia sorex.
Rhopalodia gibba var. *ventricosa.*
Rhopalodia gibberula.
Nitzschia tryblionella var. *levidensis.*
Nitzschia commutata.
Nitzschia frustulum var. *perminuta.*
Nitzschia acicularis.
Cymatopleura elliptica var. *nobilis.*
Surirella ovata and var. *pinnata.*
Surirella tientsinensis.

The following nine diatoms from Argun river are proposed as new;

Neidium dubium fo. *argunensis.*
Navicula bacillum var. *parallela.*
Navicula argunensis.
Navicula viridula var. *rostrata* and var. *argunensis.*
Navicula hungarica var. *lanceolata.*
Pinnularia tibetica var. *argunensis.*
Pinnularia viridis var. *commutata* fo. *argunensis.*
Cymbella naviculiformis fo. *constricta.*

From a geographical point of view the following diatoms are of interest: *Achnanthes Peragalli* var. *nipponica*, known from Kizaki lake, Nippon; *Frustulia vulgaris* var. *asiatica*, reported from the Great Khingan mountains, Manchoukuo; *Gyrosigma attenuatum* var. *asiatica*, reported from western China; *Caloneis Schroederii*, known from Europe; *Navicula rhynchocephala* var. *tenua*, reported from western China; *Navicula amphibola* var. *manshurica*, known from the Great Khingan mountains; *Cymbella Moelleriana*, known from Europe; *Surirella robusta* fo. *lata*, found by Fr. Hustedt in Nippon; *Surirella tientsinensis*, reported from brackish water near Tientsin, northern China, and from Hanka Lake, of Eastern Siberia.

The similarity of the diatom flora of Argun River to that of Dalai-nor Lake is borne out by a series of common species; namely: *Anomoeoneis sphaerophora, Navicula gastrum, Navicula cuspidata* and var. *ambigua, Nitzschia tryblionella* var. *levidensis, Cymatopleura elliptica, Surirella ovata,* and *Epithemia* spp.

The 163 diatoms found in the sample are described below. Half of them are figured. Both Latin and English diagnoses are given for new forms.

MELOSIRA VARIANS C. A. Agardh.

Melosira varians C. A. Agardh, Fr. Hustedt, Bacillar. (1930) 85, 86, fig. 41.

Valve height and breadth about 0.012 mm. Rare. A species of cosmopolitan distribution. Reported from North Manchuria, from rapidly running water in Imengol River, near Hailar, and the Great Khingan mountains.

MELOSIRA GRANULATA (Ehr.) Ralfs STATUS α.

Melosira granulata (Ehr.) Ralfs *status α*, FR. HUSTEDT, Bacillar. (1930) 87, 88, fig. 44.

Valve height 0.015 mm; breadth, 0.007. Striæ and granules 8 in 0.01 mm. Infrequent. Reported from plankton of lakes and rivers. Common in Sungari river, near Harbin.

MELOSIRA GRANULATA (Ehr.) Ralfs STATUS β.

Melosira granulata (Ehr.) Ralfs *status β*, FR. HUSTEDT, Bacillar. (1930) 87, 88, fig. 44.

Differs from the preceding form in the coarser striæ and granules. Valve height, 0.012 mm; breadth, 0.01. Striæ 12, granules 10 in 0.01 mm. Common.

MELOSIRA DISTANS (Ehr.) Kütz. var. ALPIGERA Grunow.

Melosira distans (Ehr.) Kütz. var. *alpigera* Grunow, FR. HUSTEDT, Bacillar. (1930) 93, fig. 64.

Valve height 0.0067 mm; breadth, about 0.005. Striæ oblique, 18 in 0.01 mm. Rare. The type was reported from the Great Khingan mountains.

MELOSIRA BINDERANA Kützing.

Melosira Binderana Kützing, FR. HUSTEDT, Bacillar. (1930) 86, 87, fig. 43.

Valve height, 0.0068 mm; breadth, 0.003. Common. Known from plankton of large lakes. Common in Baikal Lake of Siberia.

CYCLOTELLA OPERCULATA (Ag.) Kützing. Plate I, fig. 19.

Cyclotella operculata (Ag.) Kützing, FR. HUSTEDT, Bacillar. (1930) 102, fig. 66.

Diameter of the valve about 0.01 mm. Striæ 15 in 0.01 mm. Central area indistinctly punctate. Reported from littoral zones of lakes. Common.

CYCLOTELLA MENEGHINIANA Kützing fo. PLANA Fricke.

Cyclotella Meneghiniana Kützing fo. *plana* Fricke, FR. HUSTEDT, Bacillar. (1930) 100, fig. 67.

Diameter of the valve, 0.01 mm. Striæ 9 in 0.01 mm. One isolated puncta in the central area distinct. Reported from

Dalai-nor Lake, and in Transbaikalia from Kenon and Baikal Lakes. Very common.

CYCLOTELLA GLOMERATA Bachm.

Cyclotella glomerata Bachm., FR. HUSTEDT, Bacillar. (1930) 105, 106, fig. 81c.

Valve minute, about 0.0085 mm. Striæ 13 to 15 in 0.01 mm. Reported from plankton of subalpine lakes. New to Manchoukuo. Common.

STEPHANODISCUS HANTZSCHII Grunow. Plate 2, fig. 6.

Stephanodiscus Hantzschii Grunow, FR. HUSTEDT, Bacillar. (1930) 110, fig. 87.

A minute diatom with delicate radiating rows of puncta. Diameter of the valve 0.01 mm. Rows of puncta 12 in 0.01 mm. Reported from rivers and lakes. Found in winter plankton of Sungari river near Harbin. Common.

TABELLARIA FENESTRATA (Lyngb.) Kützing.

Tabellaria fenestrata (Lyngb.) Kützing, FR. HUSTEDT, Bacillar. (1930) 122, 123, fig. 99.

Known from littoral and pelagic parts of ponds and lakes. Common in mountain bogs. Reported from the Great Khingan mountains and Hailar. Rare.

DIATOMA ANCEPS (Ehr.) Grunow. Plate 1, fig. 22.

Diatoma anceps (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 130, fig. 117.

Valve linear, with produced and subcapitate ends. Length, 0. 027 mm; breadth, 0.0032. Costæ 6 in 0.01 mm. Differs from the type in its subrostrate and subacute, not capitate, ends. Rare. Reported from mountain streams and rivers.

MERIDION CIRCULARE Agardh.

Meridion circulare Agardh, FR. HUSTEDT, Bacillar. (1930) 131, 132, fig. 118.

Length, 0.037 mm; breadth, 0.005. Costæ 4 in 0.01 mm. Rare. Known from the Great Khingan mountains, Hailar, and Baikal Lake.

OPEPHORA MARTYI Heribaud.

Opephora Martyi Heribaud, FR. HUSTEDT, Bacillar. (1930) 132, 133, fig. 120.

Valve elongate, with robust costæ. Length, 0.012 mm; breadth, 0.0035. Costæ 9 in 0.01 mm. Rare. Reported from Baikal Lake.

CERATONEIS ARCUS Kützing.

Ceratoneis arcus Kützing, FR. HUSTEDT, Bacillar. (1930) 134, 135, fig. 122.

Valve arcuate, produced at the ends. Length, 0.06 mm; breadth, 0.005. Rare. Reported from Hailar and Baikal Lake.

FRAGILARIA INTERMEDIA Grunow.

Fragilaria intermedia Grunow, FR. HUSTEDT, Bacillar. (1930) 139, fig. 130.

Valve length, 0.02 mm; breadth, 0.0034. Striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

SYNEDRA ULNA (Nitz.) Ehr.

Synedra ulna (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 151, fig. 159*a*, *b*.

Very common. Reported from rivers and lakes. Known from Hailar, Great Khingan, and Baikal Lake.

SYNEDRA ULNA (Nitz.) Ehr. var. LANCEOLATA Kützing. Plate 2, fig. 7.

Synedra ulna (Nitz.) Ehr. var. *lanceolata* Kützing, A. SCHMIDT, Atlas Diatom. (1914) pl. 302, figs. 15–17, 19.

Differs from the type in its narrow-attenuate ends. Length, 0.081 mm; breadth, 0.006. Striæ 10 in 0.01 mm. Common. Reported from the Tropics.

SYNEDRA ULNA (Nitz.) Ehr. var. AEQUALIS (Kütz.) Hustedt.

Synedra ulna (Nitz.) Ehr. var. *aequalis* (Kütz.) Hustedt, FR. HUSTEDT, Bacillar. (1930) 152, fig. 164.

Several frustules. Not reported from Manchoukuo.

SYNEDRA ACUS Kütz. var. RADIANS (Kütz.) Hustedt.

Synedra acus Kütz. var. *radians* (Kütz.) Hustedt, FR. HUSTEDT, Bacillar. (1930) 155, fig. 171.

Valve length, 0.119 mm; breadth, 0.0034. Striæ 10 to 11 in 0.01 mm. Reported from littoral parts of lakes and from ponds. Infrequent.

SYNEDRA PARASITICA (W. Smith) var. SUBCONSTRICTA Grunow. Plate 1, fig. 19.

Synedra parasitica (W. Smith) var. *subconstricta* Grunow, FR. HUSTEDT, Bacillar. (1930) 161, fig. 196.

Valve lanceolate, constricted in the middle, with attenuate-capitate ends. Length, 0.019 mm; breadth, 0.0034. Striæ 18 in 0.01 mm. Rare. Reported from fresh water.

SYNEDRA VAUCHERIAE Kützing.

Synedra Vaucheriae Kützing, FR. HUSTEDT, Bacillar. (1930) 161, fig. 192.

Valve linear-lanceolate. Length, 0.02 mm; breadth, 0.0042. Striæ 15 in 0.01 mm. Infrequent. Reported from Kenon and Baikal Lakes, and from the Great Khingan mountains.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. UNDULATA (Ralfs) Rabh.

Eunotia pectinalis (Kütz.) Rabh. var. *undulata* (Ralfs) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 240.

Valve with undulate dorsal sides. Length, 0.073 mm; breadth, 0.009. Striæ 7 to 8 in 0.01 mm. Rare. Common in bogs and swamps. Reported from Baikal Lake.

EUNOTIA LUNARIS (Ehr.) Grunow.

Eunotia lunaris (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 183, 184, fig. 249.

Valve length, 0.054 mm; breadth, 0.003. Striæ about 18 in 0.01 mm. Rare. A diatom common in stagnant water. Reported from the Great Khingan mountains and from Baikal Lake.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grunow.

Eunotia praerupta Ehr. var. *inflata* Grunow, FR. HUSTEDT, Bacillar. (1930) 174, fig. 212.

Valve with arcuate dorsal margin. Length, 0.027 mm; breadth, 0.013. Striæ 8 in 0.01 mm. Rare. Reported from swamps.

EUNOTIA MONODON Ehr. var. MAJOR (W. Smith) Hustedt.

Eunotia monodon Ehr. var. *major* (W. Smith) Hustedt, FR. HUSTEDT, Bacillar. (1930) 186, fig. 255.

Valve arcuate, with capitate ends. Length, 0.127 mm; breadth, 0.01. Rare. Common in mountains in the northern part of Manchoukuo.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Upper valve with distinct longitudinal bands. Length, 0.015 mm; breadth, 0.008. Striæ 18 to 20 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *lineata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 190, fig. 262.

Common. Length, 0.027 mm; breadth, 0.02. Reported from Kenon and Baikal Lakes.

ACHNANTHES LANCEOLATA Bréb. var. **ROSTRATA** Hustedt. Plate 2, fig. 19.

Achnanthes lanceolata Bréb. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Fairly common in Argun River. Length, 0.01 mm; breadth, 0.0042. Striæ 15 in 0.01 mm. Reported from Kenon Lake.

ACHNANTHES BIASOLETTIANA Kützing. Plate 2, fig. 14.

Achnanthes Biasolettiana Kützing, FR. HUSTEDT, Bacillar. (1930) 199, fig. 283.

Valve broad, linear-elliptic, with obtuse subrostrate ends. Upper valve with narrow linear axial and central area. Lower valve with radiate striæ, very narrow axial area, and slightly enlarged central area. Length, 0.015 mm; breadth, 0.005. Striæ of the lower valve, 25 in 0.01 mm in the middle, 30 at the ends. Rare. Reported from Europe.

ACHNANTHES PERAGALLI Brun and Herib. var. **NIPPONICA** Skvortzow.

Achnanthes Peragalli Brun and Herib. var. *nipponica* SKVORTZOW, Diatoms from Kizaki Lake, Nippon (1936) pl. 2, fig. 1.

Valve lanceolate, convex, with attenuate, long ends. Length, 0.024 mm; breadth, 0.01. Upper valve with broad axial area. Central area of the lower valve with a broad stauros. Striæ 12 in 0.01 mm. Rare. Known from Kizaki Lake, Nippon.

FRUSTULIA VULGARIS Thwaites var. **ASIATICA** Skvortzow. Plate 1, fig. 39.

Frustulia vulgaris Thwaites var. *asiatica* SKVORTZOW, Diatoms from Khingan, North Manchuria (1928) 42, pl. 2, fig. 12.

Valve narrow-linear, with parallel margin and subrostrate obtuse ends. Length, 0.042 mm; breadth, 0.0068. Transverse striæ about 25 to 28 in 0.01 mm. Infrequent. Reported from the Great Khingan mountains.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. **ASIATICA** Skvortzow.

Gyrosigma attenuatum (Kütz.) Rabh. var. *asiatica* SKVORTZOW, Diatoms from Chengtu, Szechwan, Western China (1938) pl. 4, fig. 8.

Valve gently sigmoid, lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.0278 mm; breadth, 0.03. Longitudinal striæ 8, transverse 12 to 15 in 0.01 mm. Rare. Reported from Western China.

GYROSIGMA ACUMINATUM (Kütz.) Rabh. Plate 1, fig. 7.

Pleurosigma acuminatum (Kütz.) Grun., H. PERAGALLO, Monographie du Genre *Pleurosigma* (1890–1891) 20, pl. 7, fig. 30.

Valve sigmoid with attenuate ends. Length, 0.098 mm; breadth, 0.012. Striæ, longitudinal and transversal, 18 in 0.01

mm. Smaller than the type. Common. Reported from Kenon and Baikal Lakes.

CALONEIS SILICULA (Ehr.) Cleve.

> *Caloneis silicula* (Ehr.) Cleve, VAN HEURCK, Synopsis (1881-1885) pl. 12, fig. 18.

Very common, variable in size. Length, 0.054 to 0.096 mm; breadth, 0.01 to 0.015. Striæ 15 to 18 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes. A fresh and brackish-water diatom.

CALONEIS BACILLUM (Grun.) Mereschkowski.

> *Caloneis bacillum* (Grun.) Mereschkovski, FR. HUSTEDT, Bacillar. (1930) 236, fig. 360.

Valve linear, with parallel margins and broad ends. Length, 0.0306 mm; breadth, 0.005. Striæ 21 to 24 in 0.01 mm. Common. Reported from fresh and brackish water.

CALONEIS SCHROEDERI Hustedt. Plate 2, fig. 24.

> *Caloneis Schroederi* Hustedt, FR. HUSTEDT, Bacillar. (1930) 235, fig. 356.

Valve linear-elliptic, with cuneate-rounded ends. Middle part constricted. Median line filiform, slightly curved, with distinct terminal comma-shaped fissures. Axial area broad, central area a transverse fascia reaching the margin. Striæ radiate throughout, with distinct longitudinal band. Length, 0.027 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Rare. Known from Europe. New in Manchoukuo.

DIPLONEIS OVALIS (Hilse) Cleve.

> *Diploneis ovalis* (Hilse) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 390.

Valve elliptic. Length, 0.02 mm; breadth, 0.01. Striæ 21 in 0.01 mm, distinctly punctate. Rare.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naeg.) Cleve.

> *Diploneis ovalis* (Hilse) Cleve var. *oblongella* (Naeg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 249, fig. 391.

Differs from the type in its elongate valves. Punctation indistinct. Length, 0.0255 mm; breadth, 0.012. Striæ 11 in 0.01 mm. Rare.

NEIDIUM BISULCATUM (Lagerst.) Cleve.

> *Neidium bisulcatum* (Lagerst.) Cleve, FR. HUSTEDT, Bacillar. (1930) 242, fig. 374.

Valve linear, with rounded ends. Length, 0.034 mm; breadth, 0.007. Striæ about 25 in 0.01 mm. Common. Reported from mountain districts.

NEIDIUM IRIDIS (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 379.

Common and typical. Length, 0.072 mm; breadth, 0.0187. Striæ 18 in 0.01 mm. Reported from Baikal.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPHIGOMPHUS (Ehr.) Van Heurck.

Neidium iridis (Ehr.) Cleve var. *amphigomphus* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 245, fig. 382.

Differs from the type in its cuneate ends. Length, 0.057 mm; breadth, 0.015. Striæ 18 to 20 in 0.01 mm. Common. Reported from Kenon Lake.

NEIDIUM AFFINE (Ehr.) Cleve fo. HERCYNICA (A. Mayer) Hustedt. Plate 1, fig. 14.

Neidium affine (Ehr.) Cleve fo. *hercynica* (A. Meyer) Hustedt, FR. HUSTEDT, Bacillar. (1930) 243.

Valve linear-elliptic, with obtuse ends. Length, 0.032 mm; breadth, 0.0076. Striæ 22 to 24 in 0.01 mm. Common. Reported from Europe.

NEIDIUM AFFINE (Ehr.) Cleve var. AMPHIRHYNCHUS (Ehr.) Cleve.

Neidium affine (Ehr.) Cleve fo. *hercynica* (A. Mayer) Hustedt, FR. HUSTEDT, Bacillar. (1930) 243, fig. 377.

Valve linear, with rostrate ends. Length, 0.035 to 0.078 mm; breadth, 0.009 to 0.019. Striæ 25 in 0.01 mm. Common. Reported from Hailar, the Great Khingan mountains, and Baikal Lake.

NEIDIUM PRODUCTUM (W. Smith) Cleve.

Neidium productum (W. Smith) Cleve, FR. HUSTEDT, Bacillar. (1930) 245, fig. 383.

Infrequent. Valve ends produced in long subacute ends. Length, 0.045 mm; breadth, 0.014. Striæ 20 in 0.01 mm. Narrower than the type. Not common.

NEIDIUM DUBIUM (Ehr.) Cleve.

Neidium dubium (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 246, fig. 384a.

Valve elliptic, with rostrate ends. Length, 0.034 to 0.056 mm; breadth, 0.012 to 0.018. Striæ 20 to 30 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes.

NEIDIUM DUBIUM (Ehr.) Cleve fo. ARGUNENSIS fo. nov. Plate 1, figs. 6 and 14.

Differt a typo valvis anguste et polis cuneatis. Longis valvis 0.018 ad 0.024 mm; latis valvis 0.0068 ad 0.0085. Habit. in Argun rivulus, prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Differs from the type in its cuneate ends and narrower valves. Length, 0.018 to 0.024 mm; breadth, 0.0068 to 0.0085. Striæ 18 to 20 in 0.01 mm. Very common.

STAURONEIS ANCEPS Ehr.

Stauroneis anceps Ehr., FR. HUSTEDT, Bacillar. (1930) 256, fig. 405.

Common. Length, 0.064 mm; breadth, 0.014. Striæ 18 in 0.01 mm. Reported from Hailar, and from Kenon and Baikal Lakes.

STAURONEIS ANCEPS Ehr. fo. GRACILIS (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Infrequent. Length, 0.073 mm; breadth, 0.015. Reported from Baikal Lake.

STAURONEIS PHOENICENTERON Ehr. fo. GRACILIS (Dippel).

Stauroneis phoenicenteron Ehr. fo. *gracilis* (Dippel), FR. HUSTEDT, Bacillar. (1930) 255.

Valve lanceolate, tapering from the middle to acute ends. Length, 0.09 to 0.095 mm; breadth, 0.017 to 0.018. Striæ 18 to 21 in 0.01 mm. Common. Reported from Hailar, the Great Khingan mountains, and Baikal Lake.

STAURONEIS ACUTA W. Smith.

Stauroneis acuta W. Smith, FR. HUSTEDT, Bacillar. (1930) 259, fig. 415.

Not unfrequent. Length, 0.088 mm; breadth, 0.017. Striæ 11 in 0.01 mm. Reported from the Great Khingan mountains and from Sungari River.

ANOMOEONEIS SPHAEROPHORA (Kütz.) Pfitzer.

Anomoeoneis sphaerophora (Kütz.) Pfitzer, FR. HUSTEDT, Bacillar. (1930) 262, fig. 422.

Length, 0.072 mm; breadth, 0.02. Infrequent. Reported from fresh and brackish waters. Known from Kenon and Dalainor Lakes.

Genus NAVICULA Bory

NAVICULÆ ORTHOSTICHÆ CLEVE

NAVICULA CUSPIDATA Kützing.

Navicula cuspidata Kützing, FR. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Common. Length, 0.085 to 0.102 mm; breadth, 0.012 to 0.29. Striæ 12 to 14 in 0.01 mm. A species of cosmopolitan distribution. Reported from Kenon, Dalai-nor, and Baikal Lakes.

NAVICULA CUSPIDATA Kütz. var. AMBIGUA (Ehr.) Cleve.

Navicula cuspidata Kütz. var. *ambigua* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 268, fig. 434.

Differs from the type in its attenuate subrostrate ends. Length, 0.073 to 0.076 mm; breadth, 0.018 to 0.02. Striæ 18 to 24 in 0.01 mm. Very common. Reported from Kenon, Dalai-nor, and Baikal Lakes.

NAVICULÆ BACILLARES CLEVE

NAVICULA AMERICANA Ehr.

Navicula americana Ehr., FR. HUSTEDT, Bacillar. (1930) 280, fig. 464.

Valve linear, with parallel margins and broad-rounded ends. Median line bordered on each side by a siliceous rib. Axial area broad. Striæ radiate. Length, 0.047 mm; breadth, 0.014. Striæ in the middle 12 in 0.01 mm. Rare. New in Manchoukuo.

NAVICULA BACILLUM Ehr. var. PARALLELA var. nov. Plate 1, figs. 34 and 35.

Differt a typo valvis linearis cum marginem parallelis. Longis valvis 0.029 ad 0.047 mm; latis valvis 0.0085. Striis ad medio 15 ad 20, ad polos 24 ad 25 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear or elliptic, with parallel margins and broad-obtuse ends. Median line bordered by a siliceous rib. Terminal nodules with two distinct lateral expansions. Length, 0.029 to 0.047 mm; breadth, 0.0085. Striæ in the middle 15 to 20, at the ends 24 to 25 in 0.01 mm. Differs from the type in its parallel margins. Not to be confused with *Navicula Lambda* Cleve var. *nipponica* Skv. and var. *densistriata* Skv. reported from Nippon. Common.

NAVICULA PUPULA Kütz. var. **ROSTRATA** Hustedt. Plate 2, fig. 13.

Navicula pupula Kütz. var. *rostrata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 282, fig. 467c.

Valve elliptic-lanceolate, with distinct terminal lateral expansions. Length, 0.0187 to 0.025 mm; breadth, 0.007 to 0.0085. Striæ 15 to 20 in 0.01 mm. Median striæ longer and shorter. Common. Reported from Baikal Lake.

NAVICULA PUPULA Kütz. var. **CAPITATA** Hustedt.

Navicula pupula Kütz. var. *capitata* Hustedt, FR. HUSTEDT, Bacillar. (1930) 281, fig. 467e.

Valve linear, with slightly capitate ends. Length, 0.03 mm; breadth, 0.0068. Very common. Reported from Kenon and Baikal Lakes.

NAVICULA PUPULA Kütz. var. **ELLIPTICA** Hustedt.

Navicula pupula Kütz. var. *elliptica* Hustedt, FR. HUSTEDT, Bacillar. (1930) 282, fig. 467d.

Valve elliptic-lanceolate. Length, 0.0136 mm; breadth, 0.0055. Smaller than the type. Very common. Known from Baikal Lake.

NAVICULÆ DECIPIENTES CLEVE

NAVICULA CRUCICULA (W. Smith) Donk. var. **OBTUSATA** Grunow. Plate 2, fig. 1.

Navicula crucicula (W. Smith) Donk. var. *obtusata* Grunow, CLEVE and GRUNOW, Arctische Diatomeen (1880) 35, pl. 2, fig. 37.

Valve elliptic-lanceolate, with obtuse ends. Axial area very narrow, central slightly enlarged. Striæ radiate throughout, more distinct in the middle. Length, 0.032 to 0.04 mm; breadth, 0.01 to 0.012. Striæ, middle 15, at the ends 18 in 0.01 mm. Common. *Navicula crucicula* and its varieties are known from brackish water.

NAVICULA PROTRACTA Grunow. Plate 2, fig. 10.

Navicula protracta Grunow, FR. HUSTEDT, Bacillar. (1930) 284, fig. 472.

Valve lanceolate, with rostrate ends. Length, 0.02 to 0.04 mm; breadth, 0.0068 to 0.012. Striæ, middle 12 to 15, at the ends 18 to 20 in 0.01 mm. Very common. A brackish-water species.

NAVICULA ARGUNENSIS sp. nov. Plate 1, fig. 9.

Valvis elliptico-lanceolatis ad medium modice inflatis cum polis productis et subrostratis. Raphe directa filiformis, area axillaris et centralis angusta linearis. Striis radiantibus delicatissimis, 35 in 0.01 mm. Longis valvis 0.0187 mm; latis valvis 0.006. Egrege *Navicula protracta* Grun. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve elliptic-lanceolate, with subrostrate obtuse ends. Median line filiform, straight. Axial and central areas very narrow. Striæ radiate throughout, very fine, about 35 in 0.01 mm. Length, 0.0187 mm; breadth, 0.006. Rare. Species akin to Sect. *Naviculae decipientes* Cleve.

NAVICULÆ MENISCULÆ CLEVE

NAVICULA ATOMUS (Naeg.) Grunow. Plate 2, fig. 25.

Navicula atomus (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 285, fig. 484.

Valve minute elliptic, with short and broad ends. Length, 0.009 mm; breadth, 0.0028. Rare.

NAVICULÆ LINEOLATÆ CLEVE

NAVICULA CRYPTOCEPHALA Kützing.

Navicula cryptocephala Kützing, FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate, with attenuate ends. Length, 0.02 mm; breadth, 0.0042. Striæ 14 to 15 in 0.01 mm. Infrequent. Reported from fresh and brackish waters.

NAVICULA CRYPTOCEPHALA Kütz. var. **VENETA** (Kütz.) Grunow.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 295, fig. 497*a*.

Smaller and shorter. Length, 0.017 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Infrequent. Reported from Kenon Lake.

NAVICULA RHYNCHOCEPHALA Kütz. var. **TENUA** Skvortzow. Plate 1, fig. 42.

Navicula rhynchocephala Kütz. var. *tenua* SKVORTZOW, Diatoms from Chengtu, Szechwan, Western China (1938) pl. 4, fig. 13; pl. 3, fig. 24.

Valve lanceolate, gradually tapering to the subcapitate ends. Length, 0.0357 mm; breadth, 0.0077. Striæ radiate, convergent at the ends, 13 in 0.01 mm. Axial area narrow, central suborbicular. Common. Reported from Chengtu, western China.

NAVICULA VIRIDULA Kützing. Plate 1, fig. 16; Plate 2, fig. 34.

Navicula viridula Kützing, CLEVE and GRUNOW, Arctische Diatomeen (1880) 33, pl. 2, fig. 35.

Valve linear-lanceolate, with subrostrate ends. Median line filiform, with distinct comma-shaped terminal fissures. Median line enclosed in a narrow siliceous rib. Axial area indistinct and very narrow, central area large suborbicular. Striæ radiate, distinctly lineolate, convergent at the ends. Length, 0.051 to 0.066 mm; breadth, 0.009 to 0.0136. Common. Reported from fresh and brackish waters. Known from Baikal Lake.

NAVICULA VIRIDULA Kütz. var. **SLESVICENSIS** (Grun.) Cleve.

Navicula viridula Kütz. var. *slesvicensis* (Grun.) Cleve, VAN HEURCK, Synopsis (1881–1885) pl. 7, fig. 26.

Valve lanceolate, with obtuse ends. Length, 0.045 mm; breadth, 0.012. Striæ lineolate-radiate, about 8 in 0.01 mm. Infrequent.

NAVICULA VIRIDULA Kütz. var. **ROSTRATA** var. nov. Plate 1, fig. 17.

Differ a typo valvis polis rostratis. Longis valvis 0.034 mm; latis valvis 0.0085. Striis 10 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear-lanceolate, with parallel margins and rostrate ends. Median line enclosed in a siliceous rib. Axial area very narrow, central broad, suborbicular. Striæ radiate-lineate, convergent at the ends. Length, 0.034 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. A form akin to *Navicula rostellata* Kütz. Differs from *Cymbella hybrida* Grun. in its median line being enclosed in a narrow siliceous rib. Common.

NAVICULA VIRIDULA Kütz. var. **ARGUNENSIS** Skvortzow. Plate 1, figs. 11 and 31.

Navicula viridula Kütz. var. *argunensis* SKVORTZOW, Diatoms from Kenon Lake, Transbaikalia, Siberia, pl. 1, figs. 9, 33.

Valve narrow-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.031 to 0.034 mm; breadth, 0.006. Striæ 12 to 13 in 0.01 mm. Common. Reported from Kennon Lake, Transbaikalia, Siberia.

NAVICULA HUNGARICA Grun. var. **LINEARIS** Oestrup. Plate 2, fig. 15.

Navicula hungarica Grun. var. *linearis* Oestrup, FR. HUSTEDT, Bacillar. (1930) 298, fig. 507.

Valve linear, with obtuse ends. Median line straight with indistinct two lateral expansions from both sides of terminal nodules. Axial area linear, central area a short transverse fascia. Striæ slightly radiate, very robust, 8 in 0.01 mm. Length, 0.017 mm; breadth, 0.005. Rare. Reported from slightly brackish water.

NAVICULA HUNGARICA Grun. var. **CAPITATA** (Ehr.) Cleve. Plate 2, fig. 17.

Navicula hungarica Grun. var. *capitata* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 298, fig. 508.

Valve elliptic-lanceolate, with produced subcapitate ends. Length, 0.0187 mm; breadth, 0.006. Striæ 6 in 0.01 mm. Common. Reported from Baikal Lake.

NAVICULA HUNGARICA Grun. var. **LANCEOLATA** var. nov. Plate 1, fig. 48.

Differt a typo valvis lanceolatis cum polis obtusis. Longis valvis 0.02 mm; latis valvis 0.0051. Striis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalainor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve narrow-lanceolate, with obtuse ends. Lateral expansions on both sides of terminal nodules distinct. Axial area narrow, central a transverse fascia curved outwards. Striæ robust, distinctly radiate, 9 in 0.01 mm. Length, 0.02 mm; breadth, 0.0051. Differs from the type in its lanceolate valves. Common.

NAVICULA CINCTA (Ehr.) Kützing.

Navicula cincta (Ehr.) Kützing, Fr. Hustedt, Bacillar. (1930) 298, fig. 510.

Valve linear-lanceolate, with striæ in the middle longer and shorter, 12 in 0.01 mm. Length, 0.0187 mm; breadth, 0.0042. Common. Reported from Lake Kenon.

NAVICULA CINCTA (Ehr.) Kütz. var. **LEPTOCEPHALA** (Breb.) Grunow.

Navicula cincta (Ehr.) Kütz. var. *leptocephala* (Breb.) Grunow, Van Heurck, Synopsis (1881–1885) 82, pl. 7, fig. 16.

Valve with slightly subrostrate ends. Length, 0.029 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Common. Reported from the Great Khingan mountains and Baikal Lake.

NAVICULA RADIOSA Kützing.

Navicula radiosa Kützing, Fr. Hustedt, Bacillar. (1930) 299, fig. 513.

Valve narrow-lanceolate, tapering from the middle to the acute ends. Length, 0.07 mm; breadth, 0.011. Striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

NAVICULA REINHARDTII Grunow. Plate 1, fig. 21.

Navicula Reinhardtii Grunow, Fr. Hustedt, Bacillar. (1930) 301, fig. 519.

Valve elliptic, robust, with thick siliceous membrane. Striæ very robust, striolate, 6 to 8 in 0.01 mm. Length, 0.035 to

0.074 mm; breadth, 0.0136 to 0.017. Common. Reported from Hailar, Great Khingan, and Kenon and Baikal Lakes.

NAVICULA FALAISIENSIS Grun. var. **LANCEOLA** Grunow? Plate 1, fig. 38.

Navicula falaisiensis Grun. var. *lanceola* Grunow?, Fr. Hustedt, Bacillar. (1930) fig. 525.

Valve narrow-lanceolate, with attenuate ends. Central area very narrow. Striæ radiate, 18 to 20 in 0.01 mm. Length, 0.024 mm; breadth, 0.0042. Infrequent.

NAVICULA ANGLICA Ralfs.

Navicula anglica Ralfs, Fr. Hustedt, Bacillar. (1930) 303, figs. 530, 531.

Valve elliptic, with rostrate ends. Length, 0.019 mm; breadth, 0.0076. Striæ 10 to 11 in 0.01 mm. Very common. Reported from Kenon and Baikal Lakes.

NAVICULA PLACENTULA (Ehr.) Grun. fo. **ROSTRATA** A. Mayer.

Navicula placentula (Ehr.) Grun., fo. *rostrata* A. Mayer, Fr. Hustedt, Bacillar. (1930) 304, fig. 533.

Valve elliptic, with rostrate ends. Striæ robust, radiate throughout, 8 in 0.01 mm. Length, 0.047 mm; breadth, 0.015. Common. Known from Kenon Lake.

NAVICULA PLACENTULA (Ehr.) Grun. fo. **LATIUSCULA** (Grun.) Meister. Plate 1, fig. 14.

Navicula placentula (Ehr.) Grun. fo. *latiuscula* (Grun.) Meister, Fr. Hustedt, Bacillar. (1930) 304, fig. 534.

Valve broad-lanceolate, with short subacute ends. Length, 0.0238 mm; breadth, 0.0115. Striæ 8½ in 0.01 mm. Common. Smaller than the type.

NAVICULA CASTRUM (Ehr.) Donk. Plate 1, fig. 11; Plate 2, fig. 22.

Navicula castrum (Ehr.) Donk., A. Schmidt, Atlas Diatom. (1911) pl. 272, figs. 10, 11.

Valve elliptic, short, with rostrate ends. Striæ longer and shorter in the middle, about 8 to 10 in 0.01 mm. Length, 0.027 to 0.029 mm; breadth, 0.01. Common. Reported from Dalainor, Kenon, and Baikal Lakes.

NAVICULA LANCEOLATA (Agardh) Kützing. Plate 1, fig. 41.

Navicula lanceolata (Agardh) Kützing, Fr. Hustedt, Bacillar. (1930) 305, fig. 540.

Valve lanceolate, tapering from the middle to the acute ends. Striæ radiate-striolate, 9 to 11 in the middle, 12 to 15 in 0.01

mm at the ends. Length, 0.035 to 0.042 mm; breadth, 0.007 to 0.0085. Common. Reported from fresh and brackish waters.

NAVICULA OBLONGA Kütz. var. SUBPARALLELA Rattray.

Navicula oblonga Kütz. var. *subparallela* RATTRAY, Diatomaceous deposit from North Tolsta, Lewis (1887) 423, pl. 29, fig. 2; OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei (1909) pl. 1, fig. 6.

Valve linear, with almost parallel margins and obtuse ends. Length, 0.127 to 0.144 mm; breadth, 0.017 to 0.018. Striæ 6 to 7 in 0.01 mm. Infrequent. Reported from Kenon Lake. The type is known from fresh and brackish water.

NAVICULÆ PUNCTATÆ CLEVE

NAVICULA AMPHIBOLA Cleve var. MANCHURICA Skvortzow.

Navicula amphibola Cleve var. *manschurica* SKVORTZOW, Diatoms from Khingan, North Manchuria (1928) 43, pl. 2, fig. 19.

Differs from the type in its more elongate ends and coarser striæ. Length, 0.047 mm; breadth, 0.017. Striæ 12 in 0.01 mm. Infrequent. Known from the Great Khingan mountains. *Navicula amphibola* is very common in Kenon Lake.

PINNULARIA INTERRUPTA W. Smith.

Pinnularia interrupta W. Smith, FR. HUSTEDT, Bacillar. (1930) 317, fig. 573b.

Valve linear, with parallel margins and larger capitate ends. Length, 0.057 mm; breadth, 0.01. Costæ 12 to 13 in 0.01 mm. Common. Known from Baikal Lake.

PINNULARIA TIBETANA Hust. var. ARGUNENSIS var. nov. Plate 2, fig. 34.

Valvis formae typicae consimilis. Differt area centralis uni-duo-interruptis. Longis valvis 0.064 mm; latis valvis 0.015. Costis 11 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Valve linear, with parallel margins and obtuse ends. Median line filiform with distinct comma-shaped terminal fissures. Axial area dilated, central area a broad fascia, on one side reaching the margin. Length, 0.064 mm; breadth, 0.015. Costæ 11 in 0.01 mm. Differs from the type in its central area interrupted. It must not be confused with var. *stauroneiformis* Skv., reported from Soochow, China. Rare.

PINNULARIA MESOLEPTA (Ehr.) W. Smith.

Pinnularia mesolepta (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 319, fig. 575a.

Very rare. Length, 0.05 to 0.054 mm; breadth, 0.008 to 0.01. Costæ 10 to 12 in 0.01 mm. Reported from Baikal Lake.

PINNULARIA MICROSTAURON Ehr. Plate 2, figs. 11, 12, and 14.

Pinnularia microstauron Ehr., A. SCHMIDT, Atlas Diatom. (1876) pl. 44, fig. 14; pl. 45, figs. 31–34.

Valve linear, with parallel margins and subrostrate ends. Costæ divergent and convergent at the ends, 12 in 0.01 mm. Length, 0.037 to 0.054 mm; breadth, 0.008 to 0.012. Common. Reported from Dalai-nor Lake.

PINNULARIA MICROSTAURON (Ehr.) Cleve var. **BREBISSONII** (Kütz.) Hust. fo. **LINEARIS** O. Möll. Plate 1, fig. 16.

Pinnularia microstauron (Ehr.) Cleve var. *Brebissonii* (Kütz.) Hust. fo. *linearis* O. Möll., FR. HUSTEDT, Bacillar. (1930) 322.

Valve linear-lanceolate, slightly attenuate towards the obtuse ends. Length, 0.04 mm; breadth, 0.01. Striæ 12 in 0.01 mm. Common.

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Infrequent. Length, 0.034 mm; breadth, 0.008. Costæ 5 in 0.01 mm. Reported from Baikal Lake.

PINNULARIA MAJOR (Kütz.) Cleve forma.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 331, fig. 614.

Agrees closely with the type but smaller. Length, 0.119 mm; breadth, 0.017. Costæ 7 in 0.01 mm. Rare.

PINNULARIA VIRIDIS (Nitz.) Ehr.

Pinnularia viridis (Nitz.) Ehr., FR. HUSTEDT, Bacillar. (1930) 334, fig. 617*a*.

Common. Length, 0.074 mm; breadth, 0.015. Costæ 7 in 0.01 mm. Common. Reported from the Great Khingan, and Kenon and Baikal Lakes.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. **COMMUTATA** Grun. fo. **ARGUNENSIS** fo. nov. Plate 2, fig. 15.

Valvis linearibus, prae forma typica angustibus, costis robustis, levissimo divergentibus et convergentibus. Longis valvis 0.062 mm; latis valvis 0.0085. Costis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo. Legit P. A. Pavlov.

Valve linear, with parallel margins and very slightly attenuate, broad-rounded ends. Median line indistinctly complex, broad filiform. Longitudinal band indistinct. Central area broad.

Length, 0.062 mm; breadth, 0.0085. Costæ 9 in 0.01 mm. Differs from the type in its narrower valves, more robust striæ, and in not being as strongly divergent and convergent. Infrequent.

PINNULARIA NOBILIS Ehr. var. FOSSILIS Pantocsek.

Pinnularia nobilis Ehr. var. *fossilis* Pantocsek, CLEVE, Synopsis of naviculoid Diatoms (1894–1895) 2, 93; SKVORTZOW, Neogene diatoms from Wamura, Shinano Prefecture, Central Nippon, pl. 1, fig. 2.

Smaller than the type. Length, 0.165 mm; breadth, 0.02. Costæ 5 to 6 in 0.01 mm. Rare. Reported as a fossil from Europe and Nippon.

PINNULARIA ISOSTAURON (Ehr.) Grunow. Plate 2, fig. 29.

Pinnularia isostauron (Ehr.) Grunow, CLEVE, Synopsis of Naviculoid Diatoms (1894–1895) 2, 93.

Navicula viridis var. *isostauron* Grunow, CLEVE and GRUNOW, Arctische Diatomeen (1880) pl. 1, fig. 14.

Valve linear, with obtuse ends. Median line slightly flexuose, indistinct, complex. Length, 0.025 mm; breadth, 0.005. Costæ 13 in 0.01 mm. Smaller than the type. Infrequent.

PINNULARIA STREPTORAPHE Cleve var. MINOR Cleve.

Pinnularia viridis var. *minor* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 2.

Valve linear, with parallel margin and broad ends. Axial and central area narrow-lanceolate. Striæ moderately divergent in the middle and convergent at the ends, 6 in 0.01 mm. Length, 0.085 to 0.093 mm; breadth, 0.0136 to 0.015. Somewhat narrower than the type. Rare.

AMPHORA OVALIS Kützing.

Amphora ovalis Kützing, FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Common. Frustule length, 0.06 to 0.061 mm; breadth, 0.013 to 0.034. Striæ 12 in 0.01 mm. Reported from Dalai-nor and Baikal Lakes.

AMPHORA OVALIS Kütz. fo. GRACILIS (Ehr.) Cleve.

Amphora gracilis Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 101.

Frustule narrow elliptic, with rostrate ends. Length, 0.034 mm; breadth, 0.012. Common. Reported from Kenon Lake.

AMPHORA OVALIS Kütz. var. LIBYCA (Ehr.) Cleve.

Amphora libyca Ehr., A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Differs from the type in its central area distinct on the dorsal side, uniting with a blank band across the striæ. Length, 0.032 mm; breadth, 0.02. Striæ 12 in 0.01 mm. Common. Reported from the Great Khingan mountains.

AMPHORA VENETA Kützing.

Amphora veneta (Kützing), FR. HUSTEDT, Bacillar. (1930) 345, fig. 631.

Valve arcuate, semielliptic, with structureless ventral margin. Median striæ distinctly punctate, 15 to 16; end striæ 20 to 25 in 0.01 mm. Length, 0.02 mm; breadth, 0.08. Infrequent. Known from fresh and brackish water. Reported from Baikal Lake.

CYMBELLA VENTRICOSA Kützing.

Cymbella ventricosa Kützing, FR. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Infrequent. Length, 0.017 to 0.037 mm; breadth, 0.005 to 0.01. Reported from environs of Hailar, from the Great Khingan mountains, and Kenon and Baikal Lakes.

CYMBELLA TURGIDULA Grunow. Plate 1, fig. 37.

Cymbella turgidula Grunow, FR. HUSTEDT, Bacillar. (1930) 362, fig. 670.

Valve asymmetric, with one side more undulate than the other. Ends subrostrate. Length, 0.024 mm; breadth, 0.0085. Striæ, ventral 12, dorsal 9 in 0.01 mm. Infrequent. Common in tropical countries.

CYMBELLA NAVICULIFORMIS Auerswald. Plate 2, fig. 3.

Cymbella anglica LAGERSTEDT, Sotvatt., Diatomaceer fram Spitsbergen (1873) 42, pl. 2, fig. 18.

Valve naviculiform, asymmetric, with rostrate ends. Length, 0.037 mm; breadth, 0.01. Striæ, ventral 12, dorsal 9 in 0.01 mm. Common. Reported from Baikal Lake.

CYMBELLA NAVICULIFORMIS Auerswald **fo. CONSTRICTA** fo. nov. Plate 2, fig. 4.

Valvis asymmetricis, naviculiformis, prae formae typica leviter arcuatis unilateraliter constrictis. Longis valvis 0.03 mm; latis valvis 0.0085. Striis ventralis 12, dorsalis 9 in 0.01 mm. Habit. in Argun rivulis prope Chalai-nor, Manchoukuo Occidentalis. Legit P. A. Pavlov.

Differs from the type in one of its sides being constricted. Length, 0.03 mm; breadth, 0.0085. Striæ ventral 12, dorsal 9 in 0.01 mm. Infrequent.

CYMBELLA CISTULA (Hemp.) Grunow.

Cymbella *cistula* (Hemp.) Grunow, FR. HUSTEDT, Bacillar. (1930) 363, fig. 676*a*.

Infrequent. Length, 0.062 mm; breadth, 0.017. Striæ 7 in 0.01 mm. At the ventral side of the central nodule are 3 small puncta, ending the median striæ. Infrequent. Reported from the environs of Hailar, from the Great Khingan mountains, and from Kenon, Dalai-nor, and Baikal Lakes.

CYMBELLA EHRENBERGII Kützing.

Cymbella Ehrenbergii Kützing, FR. HUSTEDT, Bacillar. (1930) 356, fig. 656.

Common. Length, 0.08 mm; breadth, 0.025. Striæ 8 to 10 in 0.01 mm. Known from Kenon Lake.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 2, fig. 25.

Cymbella turgida (Greg.) Cleve, FR. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve robust, semielliptic, arcuate, with almost straight ventral margin. Length, 0.024 mm; breadth, 0.01. Striæ, ventral 8, dorsal 6 in 0.01 mm. Infrequent. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA MOELLERIANA Grunow. Plate 2, fig. 24.

Cymbella Moelleriana Grunow, A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 71–75.

Valve lanceolate, naviculiform, tapering from the middle to subacute ends. Median line robust, broad, with terminal fissures, curved to one side. Striæ radiate throughout and lineate. Central area slightly asymmetric, eccentric. Length, 0.051 mm; breadth, 0.014. Striæ 11 in 0.01 mm. The specimens from Argun river are broader than the type. A form with more robust striæ, var. *nipponica* Skv., was recently described from the neogene deposits of Nippon in Wamura, Shinano Province. The type is known from Europe. Infrequent.

CYMBELLA ASPERA (Ehr.) Cleve.

Cymbella aspera (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 365, fig. 680.

Common. Length, 0.168 mm; breadth, 0.034. Striæ dorsal and ventral 7 in 0.01 mm. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA PROSTRATA (Berkeley) Cleve.

Cymbella prostrata (Berkeley) Cleve, FR. HUSTEDT, Bacillar. (1930) 367, fig. 659.

Valve robust, arcuate, ventral side centrally gibbous, dorsal arcuate, ends obtuse. Striæ very robust, lineate, about 8 in 0.01 mm. Length, 0.03 to 0.056 mm; breadth, 0.012 to 0.0136. Not common. Reported from fresh and brackish water. Known from Kenon and Baikal Lakes.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella heteropleura Ehr. var. *minor* Cleve, SKVORTZOW, Diatomees recoltees par le Pere E. Licent au Koukounor (1935) 13, pl. 3, fig. 5.

Valve elliptic-lanceolate, with short, obtuse, ends. Length, 0.062 mm; breadth, 0.015. Striæ 10 to 12 in 0.01 mm. Our specimens differs from the var. *minor* Cleve of A. Schmidt [4] by its gradually elongate ends, and in not being rostrate as in the above figures.

CYMBELLA CUSPIDATA Kützing. Plate 2, fig. 5.

Cymbella cuspidata Kützing, A. SCHMIDT, Atlas Diatom. (1875) pl. 9, fig. 50.

Valve elliptic, with rostrate ends. Length, 0.052 to 0.083 mm; breadth, 0.017 to 0.025. Striæ 8 in 0.01 mm. Very common. Reported from the Great Khingan mountains and Baikal Lake.

CYMBELLA AEQUALIS W. Smith. Plate 2, fig. 31.

Cymbella obtusa Greg., A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 41–45.

Valve lanceolate, naviculiform, asymmetric, with produced, obtuse, ends. Length, 0.04 mm; breadth, 0.01. Striæ, ventral and dorsal 8 in 0.01 mm. Differs from the type in its more robust striæ. Infrequent. Common in mountainous districts.

CYMBELLA CYMBIFORMIS (Agardh? Kütz.) Van Heurck.

Cymbella cymbiformis (Agardh? Kütz.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 362, fig. 672.

Not common. Length, 0.059 mm; breadth, 0.014. Striæ 7 in 0.01 mm.

CYMBELLA TUMIDA (Bréb.) Van Heurck.

Cymbella tumida (Bréb.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve arcuate, with slightly undulate margins. A distinct stigma with a fissure below the central nodule. Length, 0.068

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[4] Atlas Diatom. (1875) pl. 9, figs. 51 and 52.

mm; breadth, 0.018. Not common. Reported from Baikal Lake.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. **PRODUCTA** Grun. Plate 1, fig. 27.

Gomphonema angustatum (Kütz.) Rabh. var. *producta* Grun., FR. HUSTEDT, Bacillar. (1930) 373, fig. 693.

Valve clavate, apex and basis obtuse-capitate. Length, 0.039 mm; breadth, 0.01. Striæ 7 in 0.01 mm. Common.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. **SUBELLIPTICA** Cleve.

Gomphonema parvulum (Kütz.) Grun. var. *subelliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 373, fig. 713*b*.

Infrequent. Length, 0.012 mm; breadth, 0.0034. Striæ 12 to 13 in 0.01 mm.

GOMPHONEMA CONSTRICTUM Ehr.

Gomphonema constrictum Ehr., FR. HUSTEDT, Bacillar. (1930) 377, fig. 714.

Valve with broad, capitate, apex. Length, 0.032 mm; breadth, 0.01. Rare. Reported from the environs of Hailar, from Kenon and Baikal Lakes.

GOMPHONEMA CONSTRICTUM Ehr. var. **CAPITATA** (Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitata* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 377, fig. 715.

Valve with very enlarged upper part and obtuse apex. Basis attenuate and subacute. Length, 0.034 mm; breadth, 0.0085. Infrequent. Reported from Kenon and Baikal Lakes.

GOMPHONEMA AUGUR Ehr. var. **GAUTIERI** Van Heurck.

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, FR. HUSTEDT, Bacillar. (1930) 372, fig. 689.

Valve clavate, with broad, subcapitate, apiculate, apex. Basis narrow-attenuate. Length, 0.051 mm; breadth, 0.012. Striæ 8 in 0.01 mm. Not common. Reported from Baikal Lake.

GOMPHONEMA ACUMINATUM Ehr. var. **BREBISSONII** (Kütz.) Cleve.

Gomphonema acuminatum Ehr. var. *Brebissonii* (Kütz.) Cleve, FR. HUSTEDT, Bacillar. (1930) 370, fig. 685.

Longer than the type. Length, 0.076 mm; breadth, 0.012. Infrequent. Reported from the Great Khingan mountains.

GOMPHONEMA LANCEOLATUM Ehr. forma. Plate 2, fig. 21.

Valve clavate, minute, with broad-obtuse apex and produced subacute ends. Length, 0.017 mm; breadth, 0.005. Striæ 10 in 0.01 mm. Rare.

EPITHEMIA ZEBRA (Ehr.) Kützing. Plate 2, fig. 20.

Epithemia zebra (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 384, fig. 729.

Valve variable in size. Length, 0.017 to 0.45 mm; breadth, 0.0086 to 0.013. Costæ 3, striæ 12 in 0.01 mm. Common. Reported from the environs of Hailar and Dalai-nor and Baikal Lakes.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. **PORCELLUS** (Kütz.) Grunow. Plate 1, fig. 21; Plate 2, fig. 22.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kütz.) Grunow, A. SCHMIDT, Atlas Diatom. (1904) pl. 252, fig. 21.

Valve semielliptic, arcuate. Length, 0.03 to 0.068 mm; breadth, 0.0085 to 0.0125. Costæ 3, striæ 12 in 0.01 mm. Common. Reported from Kenon and Baikal Lakes.

EPITHEMIA ZEBRA (Ehr.) Kütz. var. **SAXONICA** (Kütz.) Grunow.

Epithemia zebra (Ehr.) Kütz. var. *saxonica* (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930).

Valve arcuate, with recurved ends. Length, 0.042 mm; breadth, 0.007. Costæ 4 in 0.01 mm. Common. Reported from Kenon Lake.

EPITHEMIA TURGIDA (Ehr.) Kützing.

Epithemia turgida (Ehr.) Kützing, FR. HUSTEDT, Bacillar. (1930) 387, fig. 733.

Common. Length, 0.068 mm; breadth, 0.018. A species of cosmopolitan distribution. Reported from the environs of Hailar, in the Great Khingan mountains, and from Kenon, Dalai-nor, and Baikal Lakes.

EPITHEMIA SOREX Kützing.

Epithemia sorex Kützing, FR. HUSTEDT, Bacillar. (1930) 388, fig. 736.

Valve arcuate, with capitate ends. Length, 0.45 mm; breadth, 0.015. Common. Known from the Great Khingan mountains, the environs of Hailar, and from Kenon and Baikal Lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll.

Rhopalodia gibba (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 390, fig. 740.

Common. Length, 0.073 to 0.161 mm; breadth, 0.011 to 0.02. Common. Reported from the environs of Hailar, the Great Khingan mountains, and from Baikal Lake.

RHOPALODIA GIBBA (Ehr.) O. Müll. var. **VENTRICOSA** (Ehr.) Grunow.

Rhopalodia gibba (Ehr.) O. Müll. var. *ventricosa* (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 391, fig. 741.

Smaller than the type. Length, 0.044 mm; breadth, 0.035. Infrequent. Known from fresh and brackish waters. Reported from the environs of Hailar, from Great Khingan, and Dalai-nor and Baikal Lakes.

RHOPALODIA GIBBERULA (Ehr.) O. Müll.

Rhopalodia gibberula (Ehr.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 391, fig. 742.

Valve lunate, with produced and arcuate apices. Length, 0.032 mm; breadth, 0.018. Common. A brackish-water diatom.

HANTZSCHIA AMPHIOXYS (Ehr.) Grunow.

Hantzschia amphioxys (Ehr.) Grunow, FR. HUSTEDT, Bacillar. (1930) 394, fig. 747.

Valve slightly arcuate, with rostrate ends. Length, 0.04 mm; breadth, 0.007. Keel puncta 7, striæ 18 in 0.01 mm. Infrequent. Reported from Kenon and Dalai-nor Lakes.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. fo. **CAPITATA** O. Müll.

Hantzschia amphioxys (Ehr.) Grun. fo. *capitata* O. Müll., A. SCHMIDT, Atlas Diatom. (1921) pl. 329, figs. 13, 14.

Valve with capitate ends. Length, 0.054 mm; breadth, 0.0068. Keel puncta 6, striæ 30 in 0.01 mm. Rare.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. **INTERMEDIA** Grunow. Plate 1, fig. 6.

Hantzschia amphioxys (Ehr.) Grun. var. *intermedia* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 56, fig. 4; A. SCHMIDT, Atlas Diatom. (1921) pl. 329, fig. 4.

Valve slightly arcuate, with long, produced, subacute, ends. Length, 0.102 mm; breadth, 0.01. Keel puncta 6 to 7, striæ 14 in 0.01 mm. Common. Somewhat narrower than var. *mayor*.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. **XEROPHILA** Grunow.

Hantzschia amphioxys (Ehr.) Grun. var. *xerophila* Grunow, Diatomeen von Franz Josefs Land (1884) 47.

A form with very coarse striæ. Length, 0.04 mm; breadth, 0.0085. Keel puncta 7, striæ 30 in 0.01 mm. Rare. Reported from the environs of Hailar and from Great Khingan.

NITZSCHIA TRYBLIONELLA Hantz. var. **LEVIDENSIS** (W. Smith) Grunow. Plate 1, figs. 15 and 32; Plate 2, figs. 1 and 33.

Nitzschia tryblionella Hantz. var. *levidensis* (W. Smith) Grunow, FR. HUSTEDT, Bacillar. (1930) 399, fig. 760.

Valve elliptic-linear, with cuneate ends. Keel puncta extending across the valve. Length, 0.027 to 0.051 mm; breadth, 0.0085 to 0.01. Costæ 10 to 15 in 0.01 mm. Common. Known from slightly brackish water. Reported from Dalai-nor and Baikal Lakes.

NITZSCHIA ACUTA Hantzsch. Plate 2, fig. 6.

Nitzschia acuta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 412, fig. 790.

Valve narrow-lanceolate, with attenuate-capitate ends. Length, 0.106 mm; breadth, 0.0043. Keel puncta 7 in 0.01 mm. Common.

NITZSCHIA RECTA Hantzsch. Plate 1, figs. 4 and 28.

Hantzschia recta Hantzsch, FR. HUSTEDT, Bacillar. (1930) 411, fig. 785.

Valve linear-lanceolate, with obtuse ends. Length, 0.064 to 0.07 mm; breadth, 0.006 to 0.0068. Keel puncta 5 to 6 in 0.01 mm. Striæ indistinct. Common.

NITZSCHIA CAPITELLATA Hust. var. **SINICA** Skvortzow. Plate 1, figs. 21 and 25.

Nitzschia capitellata Hust. var. *sinica* SKVORTZOW, Diatoms from environs of Soochow, Kiangsi Province, China, I, pl. 3, fig. 11.

Valve linear-lanceolate, with parallel margins in the middle and attenuate-capitate ends. Length, 0.034 to 0.06 mm; breadth, 0.0028 to 0.003. Keel puncta 11 to 12 in 0.01 mm. Striæ indistinct. Infrequent. Reported from Soochow, China.

NITZSCHIA GRACILIS Hantzsch. Plate 1, fig. 3.

Nitzschia gracilis Hantzsch, FR. HUSTEDT, Bacillar. (1930) 416, 417, fig. 794.

Abundant. Length, 0.076 mm; breadth, 0.0021. Keel puncta 15 in 0.01 mm. Smaller than the type.

NITZSCHIA PALEA (Kütz.) W. Smith. Plate 1, figs. 19 and 31.

Nitzschia palea (Kütz.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate, with produced, obtuse, ends. Length, 0.037 to 0.04 mm; breadth, 0.005. Keel puncta 11 in 0.01 mm. Striæ indistinct. Common. Reported from Kenon Lake.

NITZSCHIA COMMUTATA Grunow. Plate 2, fig. 32.

Nitzschia commutata Grunow, FR. HUSTEDT, Bacillar. (1930) 405, fig. 774.

Valve constricted in the middle; with produced subrostrate ends. Length, 0.051 mm; breadth, 0.01. Keel puncta 6, striæ 20 in 0.01 mm. Infrequent. Reported from slightly brackish water.

NITZSCHIA FRUSTULUM (Kütz.) Grunow var. **PERMINUTA** Grun. Plate 1, fig. 26.

Nitzschia frustulum (Kütz.) Grunow var. *perminuta* Grun., VAN HEURCK, Synopsis (1881–1885) pl. 68, fig. 31.

Valve linear-lanceolate, with attenuate and obtuse ends. Length, 0.014 mm; breadth, 0.0025. Keel punta 9, striæ 30 in 0.01 mm. Rare. Reported from brackish water. Known from Dalai-nor Lake.

NITZSCHIA AMPHIBIA Grunow.

Nitzschia amphibia Grunow, FR. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve linear-lanceolate, with distinct punctate striæ. Length, 0.02 mm; breadth, 0.003. Keel puncta 6, striæ 15 in 0.01 mm. Common. Reported from Baikal Lake.

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith.

Nitzschia sigmoidea (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 419, fig. 810.

Valve sigmoid, with obtuse ends. Length, 0.122 to 0.29 mm; breadth, 0.0085 to 0.009. Keel puncta 5 to 8. Smaller than the type. Common.

NITZSCHIA FLEXA Schum. Plate 1, fig. 1.

Nitzschia flexa Schum., FR. HUSTEDT, Bacillar. (1930) 420, fig. 812.

Valve sigmoid, with obtuse ends. Length, 0.068 mm; breadth, 0.0029. Keel puncta 9 to 10 in 0.01 mm. Common.

NITZSCHIA ACICULARIS W. Smith. Plate 1, fig. 2.

Nitzschia acicularis W. Smith, FR. HUSTEDT, Bacillar. (1930) 423, fig. 851.

Abundant. Length, 0.035 to 0.081 mm; breadth, 0.0022 to 0.0025. Keel puncta 18 in 0.01 mm. Reported from fresh and brackish waters.

CYMATOPLEURA SOLEA (Bréb.) W. Smith. Plate 1, figs. 8 and 12.

Cymatopleura solea (Bréb.) W. Smith, A. SCHMIDT, Atlas Diatom. (1911) pl. 275, figs. 4–6.

Very common. Length, 0.051 to 0.17 mm; breadth, 0.008 to 0.015. Reported from the environs of Hailar, from Great Khingan, and from Kenon and Baikal Lakes.

CYMATOPLEURA SOLEA (Bréb.) W. Smith var. **APICULATA** (W. Smith) Grunow.

Cymatopleura solea (Bréb.) W. Smith var. *apiculata* (W. Smith) Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 275, fig. 12.

Differs from the type in its constricted valves with apiculate ends. Common.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. REGULA (Ehr.) Grunow. Plate 1, fig. 25.

Cymatopleura solea (Breb.) W. Smith var. *regula* (Ehr.) Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 276, figs. 10, 11.

Valve linear-elliptic, with cuneate ends. Length, 0.054 mm; breadth, 0.012. Common.

CYMATOPLEURA ELLIPTICA (Breb.) W. Smith var. NOBILIS (Hantz.) Hustedt.

Cymatopleura elliptica (Breb.) W. Smith var. *nobilis* (Hantz.), FR. HUSTEDT, Bacillar. (1930) 427, fig. 828.

Valve rhombical-elliptic, with acute ends. Length, 0.16 mm; breadth, 0.08. Rare. Reported from fresh and brackish water. Known from Kenon Lake.

SURIRELLA ROBUSTA Ehr. fo. LATA Hustedt.

Surirella robusta Ehr. fo. *lata* FR. HUSTEDT, Bacillar. aus dem Aokikosee in Japan, 170, fig. 1.

Valve broad-ovate, with one end broad-rounded and the other slightly acute. Length, 0.111 mm; breadth, 0.051. Costæ 2 in 0.01 mm. Infrequent. Known from Aokiko Lake, Nippon.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA (Ehr.) Van Heurck.

Surirella robusta Ehr. var. *splendida* (Ehr.) Van Heurck, FR. HUSTEDT, Bacillar. (1930) 437, figs. 851, 852.

Valve elongate-ovate, with costæ reaching the central area. Length, 0.088 mm; breadth, 0.034. Common.

SURIRELLA BISERIATA Breb. fo. PUNCTATA Meister.

Surirella biseriata Breb. fo. *punctata* Meister, FR. HUSTEDT, Bacillar. (1930) 432, 433.

Valve linear-elliptic, with cuneate ends. Space between costæ punctate. Length, 0.088 to 0.17 mm; breadth, 0.027 to 0.037. Common.

SURIRELLA LINEARIS W. Smith.

Surirella linearis W. Smith, FR. HUSTEDT, Bacillar. (1930) 434, figs. 837, 838.

Valve linear-elliptic, with parallel margins and cuneate ends. Length, 0.088 mm; breadth, 0.027. Common. Reported from Great Khingan and Baikal Lake.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister, FR. HUSTEDT, Bacillar. (1930).

Differs from the type in the presence of puncta along the median area. Length, 0.088 mm; breadth, 0.028. Infrequent.

SURIRELLA GRACILIS Grunow. Plate 2, fig. 27.

Surirella gracilis Grunow, A. Schmidt, Atlas Diatom. (1925) pl. 357, figs. 4–6.

Valve linear, with parallel margins and cuneate ends. Length, 0.0595 mm; breadth, 0.0085. Valve from front view slightly capitate at both ends. Infrequent. Reported from Baikal Lake.

SURIRELLA CAPRONII Brébisson.

Surirella Capronii Bréb., Fr. Hustedt, Bacillar. (1930) 440, fig. 857.

Common. Length, 0.147; breadth, 0.054. Reported from Kenon Lake.

SURIRELLA OVATA Kützing.

Surirella ovata Kützing, Fr. Hustedt, Bacillar. (1930) 442, fig. 864.

Valve elongate-ovate. Length, 0.015 to 0.027 mm; breadth, 0.0076 to 0.011. Costæ 6 in 0.01 mm. Common. A brackish-water diatom. Reported from Kenon Lake.

SURIRELLA OVATA Kütz. var. **PINNATA** (W. Smith).

Surirella ovata Kütz. var. *pinnata* (W. Smith), Fr. Hustedt, Bacillar. (1930) 442, fig. 865.

Valve ellipic-ovate, with one end broader than the other. Length, 0.051 mm; breadth, 0.0136. Costæ 5 in 0.01 mm. Infrequent.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, Fr. Hustedt, Bacillar. (1930) 436, figs. 844, 845.

Valve fusiform, with cuneate ends. Length, 0.034 mm; breadth, 0.0085. Common.

SURIRELLA TIENTSINENSIS Skvortzow. Plate 2, fig. 9.

Surirella tientsinensis Skvortzow, Diatoms from Tientsin, North China (1927) 106, fig. 14.

Valve linear, with parallel margins and broad-capitate ends. Costæ robust, reaching the median area. Between the costæ fine, closely set, parallel, lines. Length, 0.059 mm; breadth, in the middle 12, at the broader ends 14 in 0.01 mm. Costæ 6, striæ 15 to 18 in 0.01 mm. Infrequent. A species akin to *Surirella Pantocsekii* Meister, but different. Reported from slightly brackish water in Tientsin, North China, and from Hanka Lake, Eastern Siberia.

SURIRELLA TENERA Greg.

Surirella tenera Greg., FR. HUSTEDT, Bacillar. (1930) 438, 439, fig. 853.

Valve elongate-ovate, with costæ reaching the median area. Length, 0.085 mm; breadth, 0.027. Infrequent.

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ILLUSTRATIONS

PLATE I

FIG. 1. *Nitzschia flexa* Schum.
2. *Nitzschia acicularis* W. Smith.
3. *Nitzschia gracilis* Hantz.
4. *Nitzschia recta* Hantz.
5. *Hantzschia amphioxys* (Ehr.) Grun. var. *intermedia* Grun.
6. *Neidium dubium* (Ehr.) Cleve fo. *argunensis* fo. nov.
7. *Gyrosigma acuminatum* (Kütz.) Rabh.
8. *Cymatopleura solea* (Breb.) W. Smith.
9. *Navicula argunensis* sp. nov.
10. *Cyclotella operculata* (Ag.) Kütz.
11. *Navicula gastrum* (Ehr.) Donk.
12. *Cymatopleura solea* (Breb.) W. Smith.
13. *Navicula viridula* Kütz. var. *argunensis* var. nov.
14. *Navicula placentula* (Ehr.) Grun. fo. *latiuscula* (Grun.) Meister.
15. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
16. *Navicula viridula* Kütz.
17. *Navicula viridula* Kütz. var. *rostrata* var. nov.
18. *Neidium affine* (Ehr.) Cleve fo. *hercynica* (A. Mayer) Hust.
19. *Nitzschia palea* (Kütz.) W. Smith.
20. *Nitzschia recta* Hantz.
21. *Nitzschia capitellata* Hust. var. *sinica* Skv.
22. *Diatoma anceps* (Ehr.) Grun.
23. *Navicula Reinhardtii* Grun.
24. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun.
25. *Cymbella solea* (Breb.) W. Smith var. *regula* (Ehr.) Grun.
26. *Neidium dubium* (Ehr.) Cleve fo. *argunensis* fo. nov.
27. *Gomphonema angustatum* (Kütz.) Rabh. var. *producta* Grun.
28. *Nitzschia capitellata* Hust. var. *sinica* Skv.
29. *Synedra parasitica* (W. Smith) var. *subconstricta* Grun.
30. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
31. *Nitzschia palea* (Kütz.) W. Smith.
32. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
33. *Navicula viridula* Kütz. var. *argunensis* var. nov.

FIGS. 34 and 35. *Navicula bacillum* Ehr. var. *parallela* var. nov.

FIG. 36. *Pinnularia microstauron* (Ehr.) Cleve var. *Brebissonii* (Kütz.) Hust. fo. *linearis* O. Müll.
37. *Cymbella turgidula* Grun.
38. *Navicula falaisiensis* Grun. var. *lanceola* Grun.?
39. *Frustulia vulgaris* Thw. var. *asiatica* Skv.
40. *Navicula hungarica* Grun. var. *lanceolata* var. nov.
41. *Navicula lanceolata* (Ag.) Kütz.
42. *Navicula rhynchocephala* Kütz. var. *tenua* Skv.

PLATE 2

FIG. 1. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
2. *Navicula crucicula* (W. Smith) Donk. var. *obtusata* Grun.
3. *Cymbella naviculiformis* Auersw.
4. *Cymbella naviculiformis* Auersw. fo. *constricta* fo. nov.
5. *Cymbella cuspidata* Kütz.
6. *Nitzschia acuta* Hantz.
7. *Synedra ulna* (Nitz.) Ehr. var. *lanceolata* Kütz.
8. *Stephanodiscus Hantzschii* Grun.
9. *Surirella tientsinensis* Skv.
10. *Navicula protracta* Grun.
FIGS. 11 and 12. *Pinnularia microstauron* Ehr.
FIG. 13. *Navicula pupula* Kütz. var. *rostrata* Hust.
14. *Achnanthes Biasolettiana* Kütz. Lower valve.
15. *Pinnularia viridis* (Nitz.) Ehr. var. *commutata* Grun. fo. *argunensis* fo. nov.
16. *Pinnularia microstauron* Ehr.
17. *Navicula hungarica* Grun. var. *capitata* (Ehr.) Cleve.
18. *Navicula hungarica* Grun. var. *linearis* Oestrup.
19. *Achnanthes lanceolata* Breb. var. *rostrata* Hust; lower valve.
20. *Epithemia zebra* (Ehr.) Kütz.
21. *Gomphonema lanceolatum* Ehr. forma.
22. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun.
23. *Navicula gastrum* (Ehr.) Donk.
24. *Caloneis Schroederi* Hust.
25. *Navicula atomus* (Naeg.) Grun.
26. *Cymbella Muelleriana* Grun.
27. *Surirella gracilis* Grun.
28. *Cymbella turgida* (Greg.) Cleve.
29. *Pinnularia isostauron* (Ehr.) Grun.
30. *Navicula viridula* Kütz.
31. *Cymbella aequalis* W. Smith.
32. *Nitzschia commutata* Grun.
33. *Nitzschia tryblionella* Hantz. var. *levidensis* (W. Smith) Grun.
34. *Pinnularia tibetana* Hust. var. *argunensis* var. nov.

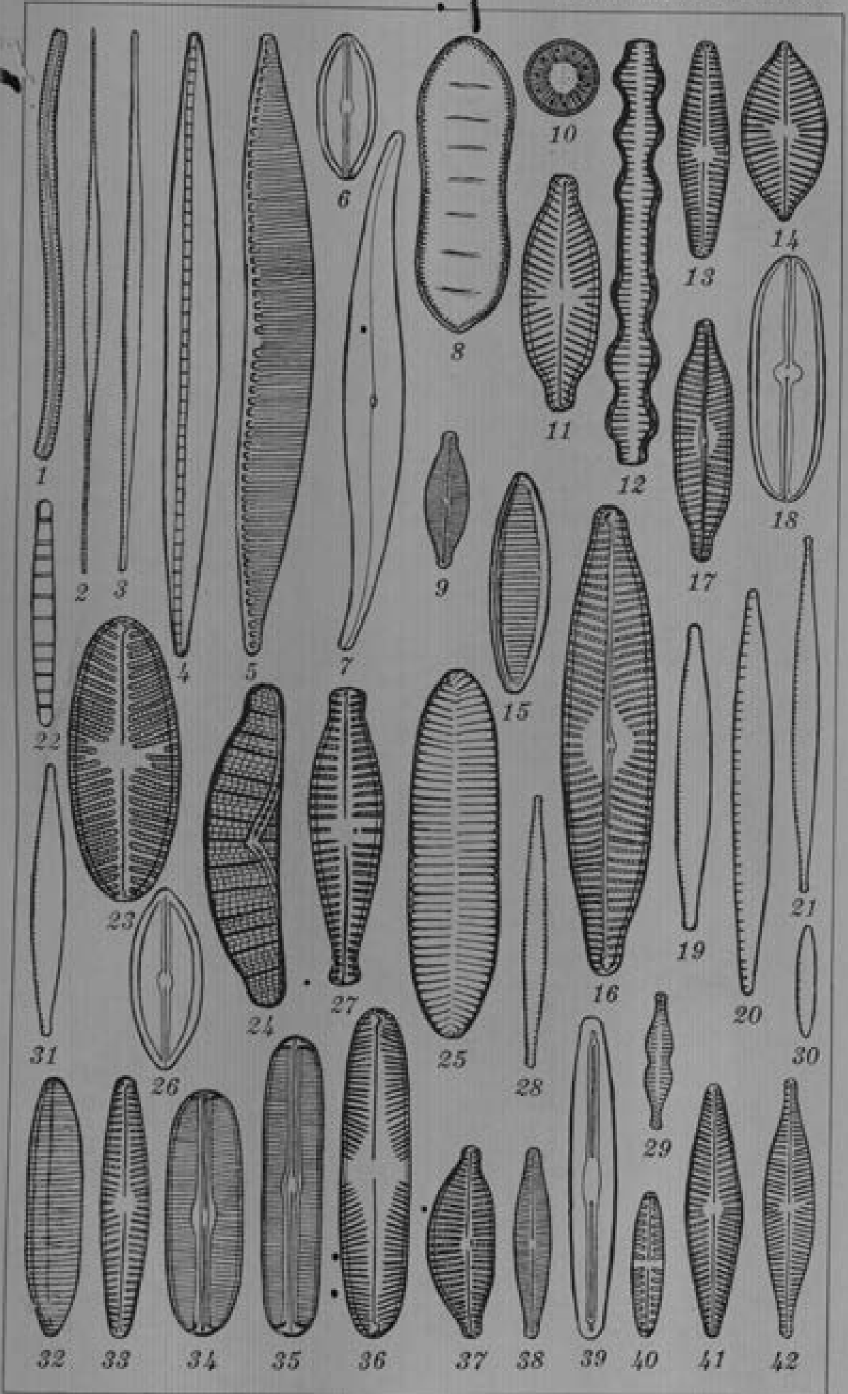

PLATE 1.

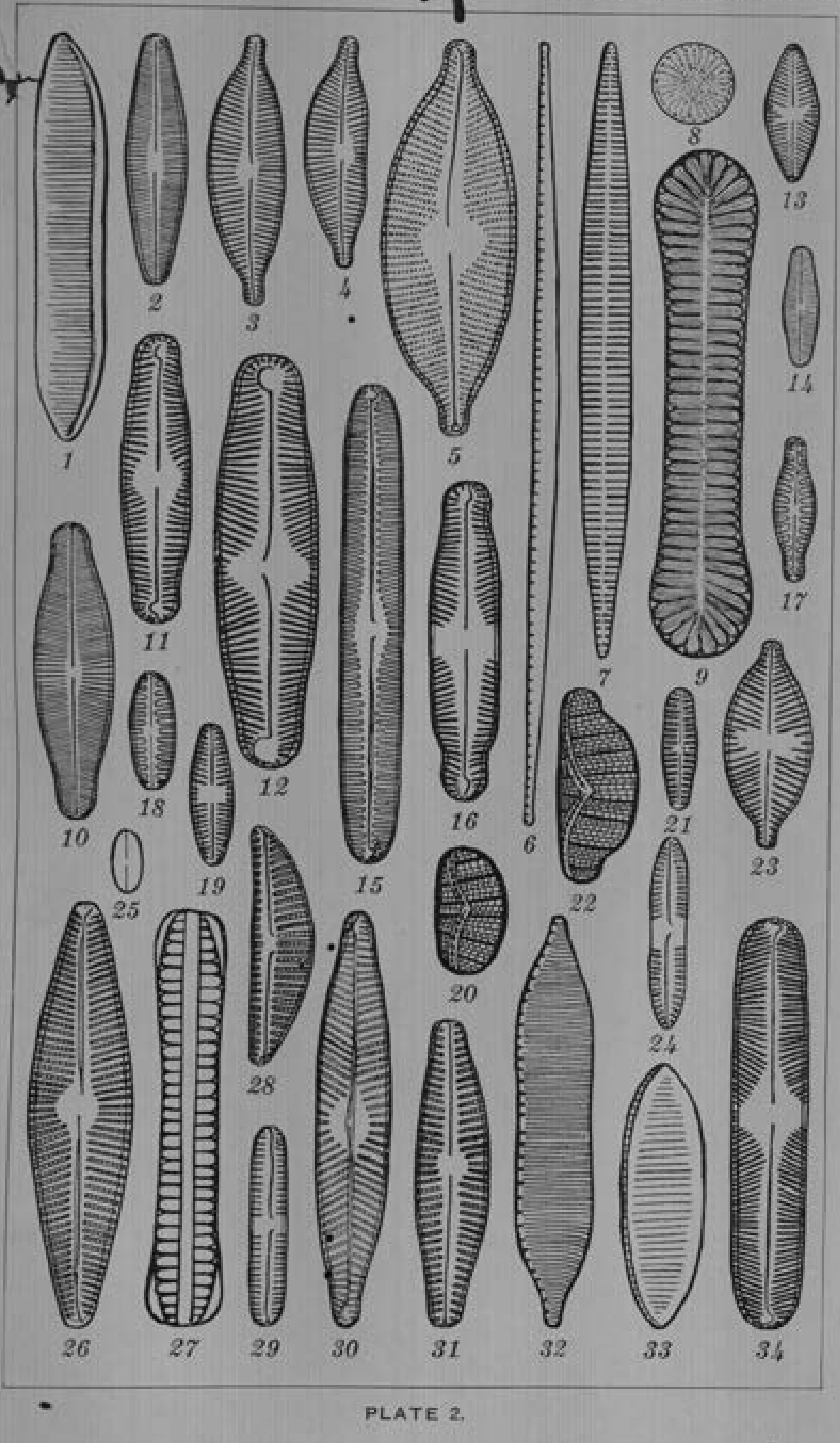
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PLATE 2.

THE EFFECT OF ARSENIC, VANADIUM, IRON, AND TIN ON THE DETERMINATION OF ANTIMONY IN HIGH-LEAD MIXTURES BY A MODIFIED PERMANGANATE METHOD.

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In a former paper (1) it was shown that antimony can be determined with a fair degree of accuracy in high-lead mixtures by a modified permanganate method. In view of the encouraging results obtained, it was decided to extend the investigation to a study of the effect of other foreign metals on the determination of antimony in high-lead mixtures. The foreign metals selected for this investigation were arsenic, vanadium, and iron, and their mixtures with tin. Separate studies were made of the effect of each of these metals on the determination of antimony, followed by combinations of two or more of them with tin.

Continued practice with the modified permanganate method showed that it could be improved by slight changes in the experimental procedure. In addition, the method was standardized by setting limits to the time of heating and to the temperatures used, and by referring all calculations of antimony found to a decinormal solution of potassium permanganate.

MODIFIED PERMANGANATE METHOD

The method as now used.—Place a gram of the high-lead mixture or alloy in a 500 cc Erlenmeyer flask and cover with a small watch glass. Add 5 grams of potassium sulphate and 15 cc of sulphuric acid. Digest the mixture at a temperature of 235° to 240° C. for 16 hours (overnight) on a hot plate. Increase the temperature to 285° or 290° C. and continue heating for 1.5 hours. Finally boil the white or nearly white liquid for 8 to 10 seconds over a Fisher burner and cool. Add 15 cc of water. Mix thoroughly and place the flask in an inclined position. The insoluble bisulphates settle out in a few minutes. Decant the nearly clear supernatant acid solution from the insoluble bisulphates into a tall lipless 400 cc Pyrex beaker. Wash with two successive 25 cc portions of a 10 per cent tartaric-acid solution, decant, and drain as before into the beaker. Add to the total washings 10 cc of hydrochloric acid.

To the washed and drained bisulphates add 40 cc of a 33 per cent ammonium-acetate solution and digest at 75° to 80° C. until complete solution is effected. Add 30 cc of water. Again digest hot for a few minutes longer and set the flask aside.

Partially cover the beaker containing the washings with a watch glass, heat the solution to the boiling point, and pass a lively current of washed carbon dioxide through it for 1 minute to eliminate the sulphur dioxide. To the boiling hot liquid add quickly, while stirring, 10 cc of hydrochloric acid and also the prepared ammonium-acetate solution of the bisulphates contained in the Erlenmeyer flask. Wash the Erlenmeyer flask with three successive 15 cc portions of water. Add the washings to the acetate solution. Cool in ice to at least 10° C., and titrate with a standard permanganate solution.

Correct the burette reading by the use of its calibration curve for the working temperature adopted. If the solution is not decinormal, multiply the corrected volume by the normality factor. Subtract 0.06 cc for the blank and multiply the finally correct volume by 5.88 to obtain the milligrams of antimony present.

General observations on the method.—In the mixtures studied, the antimony, tin, and iron dissolve rapidly in the sulphuric-acid-bisulphate mixture. The action on the lead is peculiar. After about 20 or 30 minutes the metal becomes completely disseminated in finely suspended particles, and the liquid takes on a blue-black color. This color gradually changes to gray, and finally the liquid is nearly colorless at the end of the heating.

To insure the complete conversion of the lead and other metals to bisulphates, the digestion mixture is heated to 285° or 290° C. and finally boiled. Heating for a longer time or above the temperature prescribed is not advisable, because of the possibility of the antimony being volatilized. In general it is a safe rule to heat the mixture for no longer than is necessary to obtain a colorless or nearly colorless mixture. Actual practice shows, however, that the duration of heating and the temperatures prescribed are usually necessary.

When antimony alone or antimony and tin are converted to bisulphate, the reaction is much more easily and quickly performed than in high-lead mixtures. Less than an hour is required, and a temperature as low as 215° C. may be used.

Longer heating on the hot plate, however, does not appear to be harmful.

A much more rapid conversion of high-lead alloys or mixtures can be accomplished by immediate boiling with the sulphuric-acid-bisulphate mixture. This procedure is used by Robinson.(2) In our experience, however, considerable free sulphur condenses on the colder neck of the flask. If this is not completely removed (a troublesome operation) it can cause high permanganate readings. The slower method is therefore to be preferred.

A convenient device for more rapidly bringing about the solution of the lead and other bisulphates (usually in hard crusts) in the hot ammonium acetate solution is to grind the crystals under the flat surface of the flared end of a stout glass stirring rod. By this means complete solution of the bisulphates can be effected in a few minutes.

A tall lipless 400 cc beaker for the washings and the final titration with permanganate solution has two distinct advantages over the 500 cc Erlenmeyer flask formerly used. A better mixing of the washings and the ammonium acetate solution of the bisulphates is effected, and the subsequent titration with permanganate is much more easily and accurately carried out.

Usually no immediate reprecipitation of the lead bisulphate takes place when the acetate solution is added to the boiling hot hydrochloric- and tartaric-acid mixture. Reprecipitation occurs after the cold and final washings are added. The advantage of double precipitation is therefore increased, because of the greater solubility of the formerly occluded antimony bisulphate by dilution. When the percentage of the lead is 95 or more, some precipitation does take place before dilution. The washed, ignited, and recovered precipitates after the permanganate titration were found to be variable mixtures consisting chiefly of lead sulphate (60 per cent and over), lead chloride, and some acetate.

In order to obtain sharp end points, a lively current of washed carbon dioxide is passed through the boiling liquid. This additional procedure is very effective in eliminating the sulphur dioxide which interferes with satisfactory readings, and as a result the end points are always sharp and can be easily obtained. The presence of the finely divided suspension of lead bisulphate has a distinct advantage also in this particular.

All procedures after the conversion of the metals to bisulphates should be carried out as rapidly as possible.

The final volume of the solution to be titrated is approximately 210 cubic centimeters. This conforms to the volume used in the standard permanganate method before titration.

Standardization.—By calculating the antimony equivalent for 1 cubic centimeter of strictly decinormal permanganate solution all analyses for antimony are greatly simplified. Only the normality of the solution is required, and this can be quickly and accurately determined by the McBride or sodium-oxalate method.

All standardizations recorded in this paper were made by using 200 to 300 milligrams of antimony and adding enough lead to increase the total weight of the metals to 1 gram. With 250 to 300 milligrams of antimony, more than 42 cubic centimeters of permanganate solution are required, which is not desirable and involves the danger that secondary reactions between the hydrochloric acid and the permanganate solution might take place from the undue heating of the solution titrated. It was therefore decided to base the standardization chiefly on the lower amounts of antimony used. Table 1 is a summary of the standardizations made, showing milligrams of antimony and lead used, temperatures and time on hot plate, cc of permanganate solution used, and mgs of antimony found.

TABLE 1.—*Standardization of 0.1N permanganate solution in terms of antimony per cubic centimeter of solution at 30° C.*

[NOTE.—According to the equation: $5SbCl_3 + 2KMnO_4 + 16HCl = 5SbCl_5 + 2KCl + 2MnCl_2 + 8H_2O$, 1 cc of 0.1N permanganate solution theoretically is equivalent to 6.088 mg antimony. The average of standardizations 1, 2, and 3 gives an antimony equivalent to 5.92 mg for 1 cc of 0.1N permanganate solution at 30° C. by the standard permanganate method.]

Standardization No.	Antimony.	Lead.	Temperature.	Time.	Volume of 0.1N $KMnO_4$ at 30° C.	Antimony equivalent per cc. at 30° C.
	mg.	*mg.*	*°C.*	*Hrs.*	*cc*	*mg.*
1	200	0	215-220	3-4	33.78	[a] 5.92
2	200	0	235-240	2-3	33.74	[a] 5.93
3	200	0	235-240	2-3	33.77	[a] 5.92
4	200	0	235-240	3-4	34.13	5.86
5	200	0	235-240	16	34.18	5.85
6	300	700	235-240	16	51.26	5.85
7	250	750	225-230	16	42.43	[a] 5.89
8	250	750	235-240	16	42.61	[a] 5.87
9	200	800	235-240	16	34.03	[a] 5.87
10	200	800	[b] 235-240	16	34.12	[a] 5.86
11	200	800	[b] 235-240	16	33.76	[c] 5.92
12	200	800	[b] 235-240	16	33.99	[a] 5.88

[a] The standard permanganate method was used. All the other standardizations were by the modified permanganate method.

[b] Temperature increased to 255° or 260° C. and continued for 1.5 hours.

[c] The residues were boiled over a Fisher flame from 6 to 8 seconds. Finally a lively current of washed carbon dioxide was passed through the boiling washings for 1 minute.

Disregarding the rather low standardization 6, and averaging standardizations 7 to 12 inclusive, the antimony equivalent for 1 cc of 0.1*N* permanganate solution at 30° C. is 5.886 mg. In round numbers the equivalent is therefore between 5.88 and 5.89 mg. The more conservative value 5.88 was selected.

In standardizations 6, 7, and 8, the calculated volumes of 0.1*N* permanganate solution for 200 mg of antimony were 34.16, 33.95, and 34.08 cc, respectively.

A temperature correction for 30° C. was made for all burette readings. In addition a blank correction was made also for impurities in the lead that consumed the permanganate solution. The average of three blank determinations very carefully made with 200 mg of lead and by the modified procedure gave a value of 0.059 cc, or, in round numbers, 0.06 cc, of 0.1*N* permanganate at 30° C.

Influence of hydrochloric acid.—F. Kessler(3) first described the standard permanganate method and, according to R. Fresenius(4) determined accurately the conditions under which antimony in acid solution may be satisfactorily titrated. He limited the hydrochloric acid (specific gravity 1.18 to 1.19) to not less than 10.3 and not over 20.5 per cent by volume. Using acid of about the same specific gravity, Hillebrand and Lundell(5) state that "hydrochloric acid is essential for rapid and complete oxidation of antimony by permanganate and its amount should not be less than 10 per cent nor more than 25 per cent by volume." In respect to sulphuric acid, they add, "it is also desirable in amounts approximately 10 per cent by volume." However, the concentration by volume of hydrochloric acid (specific gravity 1.18 to 1.19) used by Treadwell and Hall(6) in their description of the standard permanganate method is 9.5 per cent. The procedure is similar to that recommended by the United States Bureau of Standards. The concentration by volume of hydrochloric acid (specific gravity 1.18 to 1.19) in the modified permanganate method was also made to conform to 9.5 per cent, that of the sulphuric acid being 7.1 per cent. These percentages are decidedly under the lower limits set by Kessler, and those of Hillebrand and Lundell.

The theoretical equivalent of antimony for 1 cc of a decinormal permanganate solution is 6.088 mg. For the standard and modified permanganate methods the equivalents for 1 cc of permanganate solution are 5.923 and 5.886 mg of antimony respectively.

Incidentally an experimental study was made of the influence of different concentrations of hydrochloric acid on the antimony equivalent as determined by the modified and standard permanganate methods. The concentrations of hydrochloric acid used ranged from 9.5 per cent (that employed in the Treadwell and Hall procedure) to 19.0 per cent. Those concentrations above 9.5 per cent, as noted, are favored by Kessler and by Hillebrand and Lundell.

Tables 2 and 3 summarize the results of the experiments made and show that the antimony equivalent increases with the concentration of hydrochloric acid used, though the increase is not strictly proportional.

TABLE 2.—*Influence of increasing concentrations of hydrochloric acid in the modified permanganate method on the antimony equivalent of 0.1N permanganate solution at 30° C.*

[NOTE.—Procedure same as that used for the antimony equivalents in Table 1. Concentrations of hydrochloric acid calculated in volume per cent. Temperature of solution at the beginning of titration 5° C.; at the end, 14° C.]

Experiment No.	Antimony.	Lead.	Hydrochloric acid concentration.	Antimony equivalent per cc.
	mg.	*mg.*	*Per cent.*	*mg.*
1	250.0	750.0	9.5	[a] 5.801
2	250.0	750.0	11.9	5.944
3	250.0	750.0	14.2	[a] 6.000
4	250.0	750.0	16.6	[b] 6.012
5	250.0	750.0	19.0	[b] 6.039

[a] Duplicate determinations made.

[b] End point evanescent.

TABLE 3.—*Influence of increasing concentrations of hydrochloric acid in the standard permanganate method on the antimony equivalent of 0.1N permanganate solution at 30° C.*

[NOTE.—Procedure same as that used for the antimony equivalents in Table 1. Concentrations of hydrochloric acid calculated in volume per cent. Theoretical value of 1 cc 0.1N $KMnO_4$=6.088 mg Sb. Temperature of solution at the beginning of titration 5° C.; at the end, 14° C.]

Experiment No.	Antimony.	Tin.	Hydrochloric acid concentration.	Antimony equivalent per cc.
	mg.	*mg.*	*Per cent.*	*mg.*
1	200.0	200.0	9.5	5.925
2	200.0	200.0	11.9	5.962
3	200.0	200.0	14.2	5.985
4	200.0	200.0	16.6	[a] 6.002

[a] End point evanescent.

It is probable that small amounts of antimony are volatilized in the modified permanganate method. At any rate this possibility is always present in boiling hot and more highly concentrated hydrochloric acid solutions. For that reason it was decided to adhere to the 9.5 per cent concentration of the acid, and in strict agreement with the Treadwell and Hall procedure for the standard permanganate method. Finally the continued use of this procedure in recent years by many chemists indicates strongly that its accuracy is satisfactory.

Apparatus and chemicals.—Two acid burettes were used for the titrations. One of these was a 50 cc burette graduated in 0.1 cc at 27.5° C., and the other a 10 cc microburette graduated in 0.01 cc at 27.5° C., and inspected by the Physicalisch-Technische Reichsanstalt.

Both burettes were carefully calibrated at the average working temperature of 30° C.

The antimony, tin, and lead used were the pure "analysed" grade, manufactured by Baker and Company. Arsenic, as arsenious acid, Standard Sample No. 83, was prepared by the United States Bureau of Standards. Vanadium, as vanadic acid (V_2O_5), was manufactured by Kahlbaum. Iron in the form of iron wire was of the C. P. grade and contained 99.8 per cent of the metal.

All the other chemicals used were of the C. P. "analysed" grade.

Whenever acids are mentioned in this paper the following concentrations were employed: Hydrochloric acid, concentrated, specific gravity 1.18; sulphuric acid, concentrated, specific gravity 1.84.

In all solutions used the percentage concentration was by weight. In respect to the ammonium-acetate solution 1 pound of the pure salt dissolved in 922 cc of water gives approximately the desired concentration of 33 per cent by weight. The specific gravity of this solution at 15.6° C. is 1.059 to 1.060.

EXPERIMENTAL RESULTS

The effect of arsenic.—During the conversion of the antimony, lead, and other metals to bisulphates by the modified permanganate method, the arsenic remains in its trivalent form—probably as arsenious acid. In the subsequent titration with permanganate solution both the trivalent arsenic and the antimony are oxidized to their quinquevalent forms. The effect of the arsenic is therefore positive, and higher results for the antimony are obtained.

No simple procedure is known at present for the selective oxidation of the arsenic in the presence of antimony. Neither can the arsenic be completely volatilized, even at the temperatures of 235° C. and higher that prevail in the method. A correction is therefore necessary. The correction is made by multiplying the milligrams of arsenic known to be present by some factor and subtracting the product from the apparent antimony reading.

In the standard permanganate method Hillebrand and Lundell(5) use the factor 1.86. However, this is too high, because some of the arsenic is volatilized at the temperatures above 200° C. used in the modified permanganate method.

Six careful determinations of antimony were made in which varying quantities of arsenic were taken, and a new factor, 1.66, was calculated. If the arsenic does not exceed 1 per cent of the antimony present no correction is necessary, as shown by many repeated observations.

Table 4 is a summary of the effect of arsenic on antimony in high-lead mixtures. The limits of the antimony range from

TABLE 4.—*Effect of arsenic on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Arsenic.			
	mg.	mg.	mg.	mg.	Per cent.
1	972.5	2.5	25.0	24.3	—2.8
2	944.7	5.2	50.1	49.4	—1.4
3	944.9	5.0	50.1	49.1	—2.0
4	899.5	0.5	100.0	99.7	—0.3
5	899.5	0.5	100.0	99.6	—0.4
6	899.4	0.6	100.0	99.4	—0.6
7	899.2	0.8	100.0	99.4	—0.6
8	898.8	1.0	100.2	99.2	—1.0
9	899.0	1.0	100.0	100.2	+0.2
10	899.0	1.0	100.0	100.8	+0.8
11	898.6	1.4	100.0	99.2	—0.8
12	897.0	2.5	100.5	99.3	—1.2
13	894.9	5.0	100.1	100.1	0.0
14	895.0	5.0	100.0	100.5	+0.5
15	890.0	10.0	100.0	100.4	+0.4
16	799.0	1.0	200.0	199.5	—0.3

NOTE.—The arsenic correction 1.66 was used only when the ratio of the arsenic to the antimony was greater than 1:100. A microburette calibrated at 30°C. was used for samples 1, 2, and 3.

25 to 200 mgs, or from 2.5 to 20 per cent of the total metal used.

Table 4 shows that (*a*) the percentage of error is less than 1 in most of the experiments, the average being 0.4, if sample 1 is excluded; (*b*) the percentage of error tends to increase as the amount of antimony is decreased to 50 and 25 mgs; and (*c*) the precision is good.

The effect of vanadium.—The effect of vanadium on the determination of antimony is a negative one, and is therefore the opposite to that of arsenic. Rather low results were obtained in all the experiments. This finding is not in agreement with the general properties of vanadium.

Vanadium as vanadic acid (V_2O_5) is reduced to the green trivalent form during the action of hot sulphuric acid on the high-lead mixtures. Theoretically at least, trivalent or quadrivalent vanadium should be oxidized to the quinquevalent form after subsequent dilution and titration with permanganate solution. In this regard a well-known volumetric method confirms this principle in practice.

It was thought that possibly the ammonium acetate in some way prevented the oxidation of trivalent vanadium, and at the same time interfered with the more accurate determination of the antimony by the modified permanganate method. In order to test this point, two experiments were made on the determination of the antimony in the presence of vanadium as vanadic acid (V_2O_5) by the standard permanganate method, in which, of course, no ammonium acetate is used. For the first experiment 100 mgs of antimony and 100 mgs of tin were mixed with 10 mgs, and in the second experiment with 5 mgs, of vanadium as vanadic acid (V_2O_5).

These experiments were quite similar to samples 8 and 9 in Table 5, differing only in that tin was substituted (but in smaller quantity) for the lead.

The findings were interesting. In the experiment with 10 mgs of vanadium the percentage of error was +2.3, in that with 5 mgs, +0.9. The results are in striking contrast to those from samples 8 and 9, Table 5, where the modified permanganate method was used, and in which the percentage of error for both was −2.5.

It is highly probable, therefore, that ammonium acetate does exert a disturbing effect on the determination of antimony when vanadium is present.

Table 5 is a summary of the effects of vanadium on the determination of antimony by the modified permanganate method.

TABLE 5.—*Effect of vanadium on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture. Base metal. Lead.	Mixture. Foreign metal. Vanadium.	Antimony used.	Antimony found.	Error.
	mg.	*mg.*	*mg.*	*mg.*	*Per cent*
1	973.5	1.5	25.0	24.5	−2.0
2	972.5	2.5	25.0	24.9	−0.4
3	947.5	2.5	50.0	48.4	−3.2
4	945.0	5.0	50.0	49.4	−1.2
5	897.5	2.5	100.0	98.1	−1.9
6	897.5	2.5	100.0	95.4	−4.6
7	895.0	5.0	100.0	98.0	−2.0
8	895.0	5.0	100.0	97.5	−2.5
9	890.0	10.0	100.0	97.5	−2.5
10	790.0	10.0	200.0	187.2	−6.4
11	790.0	10.0	200.0	190.7	−4.6

NOTE.—The results for "Antimony found" are given without correction. A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

Table 5 shows that (*a*) the percentage of error in most of the experiments is fairly close to 2, and (*b*) that the results tend to be erratic.

The effect of iron.—In the determination of antimony, iron acts very similarly to vanadium. The negative effect is followed by rather low results in all the experiments made, which is contrary to usual experience. Theoretically, at least, in the hot sulphuric acid high-lead mixtures iron would be reduced to the divalent form. During the subsequent dilutions, boiling temperatures, and frequent exposure to air, most of the divalent iron becomes oxidized to its trivalent form. The tendency would be toward slightly higher results than the amount of antimony actually present. However, in the actual analysis of bearing metal for antimony by the standard permanganate method small amounts of iron do not interfere. Therefore the presence of small amounts of iron should cause no especial difficulty in the determination of antimony by the use of either method. Divalent iron differs from trivalent or quadrivalent vanadium in these respects.

It is highly probable that ammonium acetate, as in the vanadium experiments, acts with the iron in an adverse manner on the determination of antimony.

In respect to the iron, however, the percentage of error in a negative way is fairly even, and in most of the experiments approximates 2. So that if the antimony readings are multiplied by 6, that is, 5.88 × 1.02, the per cent of error is less than 1.

Table 6 is a summary of the effects of iron on the determination of antimony by the modified permanganate method. The percentages of error are not corrected.

TABLE 6.—*Effect of iron on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Iron.			
	mg.	mg.	mg.	mg.	Per cent.
1	972.5	2.5	25.0	24.4	−2.6
2	947.5	2.5	50.0	48.6	−2.8
3	945.0	5.0	50.0	49.1	−1.8
4	939.8	10.2	50.0	48.9	−2.2
5	897.5	2.5	100.2	97.8	−2.2
6	897.0	2.4	100.0	97.6	−2.4
7	895.0	5.0	100.0	98.5	−1.5
8	895.0	5.1	100.2	97.6	−2.4
9	890.0	10.0	100.0	98.2	−1.8
10	890.4	10.1	100.2	97.7	−2.5
11	790.0	10.0	200.0	198.1	−1.0

NOTE.—A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

TABLE 7.—*Effect of iron on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.			Antimony found.	Error.
	Base metal.	Foreign metal.	Antimony used.		
	Lead.	Iron.			
	mg.	mg.	mg.	mg.	Per cent.
1	972.5	2.5	25.0	24.9	−0.4
2	947.5	2.5	50.0	49.6	−0.8
3	945.0	5.0	50.0	50.1	+0.2
4	939.8	10.2	50.0	49.9	−0.2
5	897.5	2.5	100.2	99.8	−0.2
6	897.0	2.4	100.0	99.6	−0.4
7	895.0	5.0	100.0	100.5	+0.5
8	895.0	5.1	100.2	99.6	−0.4
9	890.0	10.0	100.0	100.2	+0.2
10	890.4	10.1	100.2	99.7	−0.3
11	790.0	10.0	200.0	198.1	+1.0

NOTE.—The mgs of "Antimony found" in the table above are obtained by multiplying those in Table 6 by the factor 1.02.

A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

Table 7 is a repetition of Table 6, but with the amounts of antimony found corrected after multiplying by the factor 6.

Tables 6 and 7 show that (*a*) the actual per cent of error is quite uniform, even when considerable variation exists in the amounts of antimony and iron taken; (*b*) precision is excellent; and (*c*) if the factor 6 is used, the percentage of error is less than 1.

The effect of arsenic and iron.—Table 8 shows pretty convincingly that the effects of the arsenic and iron are additive. In other words, the normally high burette readings for the arsenic are compensated by the low readings for the iron.

TABLE 8.—*Effect of arsenic and iron on the determination of antimony in high-lead mixtures.*

[NOTE.—Since, according to Tables 6 and 7, iron averages 2.0 per cent too low, a correction can be introduced by multiplying the milligrams of antimony found by 1.02 or the corrected burette reading by (5.88 x 1.02) or 6. In the table shown this is done first and the arsenic correction then applied, as in *b*.]

Sample No.	Mixture.				Antimony found.		Error.	
	Base metal.	Foreign metals.		Antimony used.				
	Lead.	Arsenic.	Iron.		*a*.	*b*.	*a*.	*b*.
	mg.	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*Per cent.*	*Per cent.*
1	946.0	2.5	2.5	50.0	49.0	50.1	−2.0	+0.2
2	940.0	5.0	5.0	50.0	49.3	50.2	−1.4	+0.4
3	895.0	2.5	2.5	100.0	98.3	100.4	−1.7	+0.4
4	890.0	5.0	5.0	100.0	99.0	101.1	−1.0	+1.1
5	880.0	10.0	10.0	100.0	98.1	100.4	−1.9	+0.4
6	880.0	10.0	10.0	100.0	96.2	98.5	−3.8	−1.5
7	845.0	2.5	2.5	150.0	145.4	148.5	−3.0	−1.0
8	795.0	2.5	2.5	200.0	196.0	200.0	−2.0	0.0
9	782.7	10.0	5.7	201.6	202.4	206.8	+0.3	+2.5

[a] "Antimony found" and its percentage of error is obtained by the arsenic correction only.

[b] "Antimony found" and its percentage of error is obtained by combining the iron and arsenic corrections.

The "Antimony found" and the percentage of error calculated in column *a* in Table 8 were obtained by the use of the arsenic correction alone. With the exception of sample 9 all percentages of error are negative.

The "Antimony found" and the percentage of error calculated in column *b* were obtained by combining the arsenic and antimony corrections. With the exception of samples 4 and 9 the percentages of error are close to 1 or slightly less. The maximum percentage of negative error observed was 1.5 for sample 6 where relatively large amounts of arsenic and iron were present.

In practice the combined arsenic and iron correction is obtained by first multiplying the final antimony reading by 6 (approximately the product of the standard antimony equivalent 5.88 by 1.02, Table 7), and subtracting from this the product of mgs of arsenic present by 1.66, Table 4.

The precision observed in samples 5 and 6 is only fair. The conclusion is well supported that the combined arsenic and iron correction gives more satisfactory results than the arsenic correction alone.

The effect of arsenic, iron, and tin.—The effect of arsenic, iron, and tin on the determination of antimony in high-lead mixtures is complicated. If the combined arsenic and iron correction is used, the percentages of error show an erratic tendency. Evidently the tin has some disturbing effect on the iron. For this reason it was decided to apply the arsenic correction only. The correction was disregarded, however, when the ratio of the arsenic to the antimony was less than 1:100.

Table 9 is a summary of the results obtained.

TABLE 9.—*Effect of arsenic, iron, and tin on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.					Antimony found.	Error.
	Base metal.	Foreign metals.			Antimony used.		
	Lead.	Arsenic.	Iron.	Tin.			
	mg.	mg.	mg.	mg.	mg.	mg.	Per cent.
1	977.5	1.0	1.0	0.5	20.0	19.4	—3.0
2	972.5	1.0	1.0	0.5	25.0	24.3	—2.8
3	937.5	2.5	2.0	1.0	50.0	49.6	—0.7
4	916.5	2.0	5.0	3.0	75.0	74.8	—0.3
5	887.5	5.0	2.5	5.0	100.0	98.3	—1.7
6	887.5	5.0	2.5	5.0	100.0	98.5	—1.5
7	802.5	5.0	2.5	10.0	180.0	180.2	+0.1
8	746.0	0.5	2.5	1.0	250.0	250.1	+0.04

NOTE.—The arsenic correction alone was used, and this only when the ratio of the arsenic to the antimony was greater than 1:100.

A microburette calibrated at 20° C. was used for samples 1, 2, and 3.

The highest percentages of negative error obtained (— 2.8 and — 3) are confined to those experiments in which the antimony is low. This result, in general, agrees with the results obtained with the other experimental mixtures under similar conditions.

When the antimony is increased, the percentage of error is considerably diminished, and is usually less than 1. In respect to samples 5 and 6 precision is good.

The effect of arsenic, vanadium, iron, and tin.—The effect of arsenic, vanadium, iron, and tin on the determination of antimony is shown in Table 10.

TABLE 10.—*Effect of arsenic, vanadium, iron, and tin on the determination of antimony in high-lead mixtures.*

Sample No.	Mixture.						Antimony found.	Error.
	Base metal.	Foreign metals.				Antimony used.		
	Lead.	Arsenic.	Vanadium.	Iron.	Tin.			
	mg.	mg.	mg.	mg.	mg.	mg.	mg.	Per cent.
1	988.0	2.0	1.0	2.0	2.0	5.0	4.8	−4.0
2	986.5	1.0	0.5	1.0	1.0	10.0	10.4	+4.0
3	968.0	2.0	1.0	2.0	2.0	25.0	24.2	−3.2
4	943.7	1.2	0.5	2.5	2.1	50.0	49.3	−1.4
5	873.0	10.0	2.0	5.0	10.0	100.0	99.0	−1.0
6	895.5	1.0	0.5	2.0	1.0	100.0	98.9	−1.1
7	844.3	1.5	0.2	2.5	1.5	150.0	149.6	−0.3
8	820.0	1.5	0.5	2.0	1.0	175.0	174.5	−0.3
9	793.3	2.5	0.2	2.0	2.0	200.0	196.7	−1.7
10	745.0	1.0	0.5	2.5	1.0	250.0	247.7	−0.9

NOTE.—The arsenic correction alone was used, and this only when the ratio of the antimony to the arsenic was greater than 1 : 100.

A microburette calibrated at 30° C. was used for samples 1, 2, 3, and 4.

On account of the increased complications in the mixtures studied it was found impossible to arrive at any satisfactory correction for the vanadium and iron. In a general way, however, these metals do not seem to exert any major effect on the determination of antimony under the experimental conditions present. A correction for the arsenic alone was made, therefore, when its proportion to the antimony was greater than 1 : 100.

With the exception of those experiments in which the antimony was low, the highest per cent of error was not over − 1.7.

DISCUSSION OF RESULTS

All determinations of antimony made by the use of a standard solution of potassium permanganate are referred to the decinormal concentration at 30° C. The average of six careful standardizations gives a value of 5.886 milligrams of antimony for the equivalent of 1 cubic centimeter of the standard solution. The rounded and more conservative value of 5.88 is used here. In respect to the standard permanganate method the antimony equivalent per cubic centimeter is 5.92. By means of these constants, the determination of antimony is greatly simplified. Only the normality of the permanganate solution is required, and this can be easily and accurately determined by the McBride or sodium-oxalate method.

The possibility of losses of antimony from the boiling hot hydrochloric acid solutions used in the modified permanganate method was pointed out. The 9.5 percentage concentration of hydrochloric acid is therefore to be preferred. The continued use of this concentration according to the Treadwell and Hall procedure in the standard permanganate method supports this choice.

Seven tables are given showing the effects of arsenic, vanadium, and iron, and their admixtures with tin, on the determination of antimony by the modified permanganate method.

The effect of arsenic on the determination of antimony is to give high results. Above 200° C. in sulphuric acid solutions small amounts of arsenic are volatilized. However, the arsenic cannot be completely volatilized or selectively oxidized without disturbing the antimony, and hence a correction is necessary. The milligrams of arsenic present multiplied by the empirical factor 1.66 were therefore subtracted from all antimony readings when the arsenic was greater than 1 : 100. With this correction the per cent of error in most of the experiments was less than 1, and precision fair.

Vanadium acts in a peculiar way. Its general effect on antimony determinations is to give low results, possibly due to the presence of ammonium acetate. In addition, when vanadium is over 2 : 1000 in the lead antimony mixtures it acts as a positive catalyst, the complete conversion of the lead and other metals to bisulphates requiring in many instances not over an hour or two. The percentage of error in the mixtures studied ranged from 0.6 to 6.4, the average being about 2.8 per cent, which is higher than desirable. There is also an erratic tendency shown, and precision is only fair. On account of the variable effect of vanadium no correction was made.

When iron is introduced into lead-antimony mixtures, the effect on the determination of antimony is to give low results. This effect is similar to that of vanadium, as noted. However, the low results from iron show a uniformity even when there is considerable variation in it and also in the antimony. A correction is therefore introduced, by multiplying the milligrams of antimony found by the factor 1.02, or, much more simply, the final burette readings by 6.00; that is, 1.02 × 5.88. When this is done the percentage of error in all but one of the experiments is less than 1. The highest percentage of error is 1. Precision is good. Tables 6 and 7 show the antimony found, without and with corrections.

If arsenic and iron are added to the lead-antimony mixture, the effect is approximately additive, as shown in Table 8. In all but two of the experiments there is a decided reduction in the percentage of error which averages less than 1. An exception to be noted is the experimental mixture 9, in which the percentage of error for the combined correction is + 2.5, compared to + 0.3 when the arsenic correction alone is used. The negative effect of the error appears to be considerably lessened, as the milligrams of antimony increase to the 200 milligram limit. In this case precision is fair. The combined correction is made by multiplying the final burette reading by 6 and then applying the correction for arsenic; that is, (B. R. × 6)—1.66 mg As.

When the investigation was extended to include tin, and finally vanadium, with arsenic and iron the complications naturally increase. It is possible that tin tends to reduce the negative effect of the iron and vanadium on the antimony determination in some manner, since erratic results are obtained when the combined arsenic and iron correction are applied. On account of this finding only the arsenic correction is used. In most of the experimental mixtures the percentage of error is considerably less than 2, but increases to a little over 4 when the antimony is reduced to the lower limits of 10 and 5 milligrams. Precision is good in the tin admixture table (Table 9).

To a certain extent the correction for arsenic and iron required by the method may be considered objectionable, since separate determinations of these should be made if greater accuracy is desired. However, in view of the fact that the modified permanganate method is direct, requires only 1 gram of metal, few chemicals, and the simplest apparatus, it would seem that the correction objection is not a serious one. The further fact that in high-lead alloys similar in kind to the mixtures experimented with, special devices must be used to eliminate the large quantities of lead present, also should be considered. A final advantage lies in the relatively short time required (about 90 minutes after the conversion of the metals to sulphates) to complete the antimony determination.

The effects of bismuth, copper, cadmium, and zinc on the determination of antimony by the modified permanganate method were not investigated. These metals are very stable in solution to oxidizing agents. In addition they occur in small quantities in antifriction metal, many analyses of which have been made for antimony by the standard permanganate method. So far no interferences have been observed. Therefore it is highly probable that bismuth, copper, cadmium, and zinc in small quantities exert no objectionable effects on the modified permanganate method.

SUMMARY

A modified permanganate method has been described for the determination of antimony in high-lead mixtures.

Results showing the effects of foreign metals on the application of the modified permanganate method have been obtained.

The particular foreign metals employed in the investigation were arsenic, vanadium, and iron. Admixtures of these metals with tin were also used.

The modified permanganate method has been used successfully for the determination of antimony in high-lead mixtures.

The method was tested rigorously between the limits of 0.5 and 25 per cent for antimony and 73.5 to 98.8 per cent for lead. The maximum percentage of the foreign metals, arsenic, vanadium, iron, and tin was 1.

For high-lead mixtures or alloys the method is quite rapid, as it requires only about 90 minutes after the conversion of the metals to bisulphates.

The method is quite satisfactory, since it avoids the use of special apparatus and the tedious sulphide separation.

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NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVI[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

THREE PLATES

The crane flies discussed in this paper were included in extensive shipments of these flies received from Japan and Formosa, collected by Messrs. Takeo Kato, Hiromu Yamamoto, and Ryoichi Takahashi; from southeastern China, taken by Mr. J. Linsley Gressitt and Mr. Ernest R. Tinkham, together with additional materials taken by a native collector employed by Mr. Tinkham; and from Sumatra and Java, collected by Mrs. M. E. Walsh. All of the types are preserved in my collection of these flies, and I wish to express my very deepest thanks to all of the above-mentioned entomologists for their continued interest in saving these flies which are too often ignored by collectors of insect specimens.

TIPULINÆ

PLOCIMAS MAGNIFICUS Enderlein. Plate 1, fig. 1; Plate 3, fig. 25.

Plocimas magnificus ENDERLEIN, Zool. Anzeig. 52 (1921) 226, 227.

Enderlein described this beautiful fly from both sexes, the specimens being taken at and near Canton, Kwangtung, China, in 1911 by von Mell. One female, Hong San, southeastern Kiangsi, altitude 3,000 feet, June 22, 1936 (*Gressitt*).

The specimen differs in some regards from the type description.

Female.—Length, about 35 millimeters; wing, 22.5.

Outer segments of palpi black. Frontal prolongation of head elongate, much as in the genus *Clytocosmus* Skuse, but with a distinct nasus. Intermediate præscutal stripes paler at cephalic ends. Each scutal lobe with two dark areas; these, like the præscutal stripes, subnitidous, narrowly bordered by more opaque brown; præscutal interspaces with sparse setæ; lateral portions of scutal lobes with long erect black setæ; scutellum with long coarse golden setæ; parascutella glabrous, paler yellow. Femora obscure yellow, tips narrowly (1 to 1.5 millimeters) blackened. Wings with a dark spot at origin of Rs and a broad seam along vein 2d A.

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[1] Contribution from the Department of Entomology, Massachusetts State College.

A few additional generic and specific characters may be noted. The antennæ of the female sex (Plate 2, fig. 25) on each flagellar segment beyond the first have three setæ on outer face at and beyond midlength; lower or larger ventral lobe with one very long verticil that exceeds in length the entire segment, as well as two shorter, unequal bristles, the longer of which becomes progressively longer on the outer segments; outer or smaller lobe of flagellum without major setæ; terminal segment prolonged at tip. Tibial spur formula 1-2-2; claws (female) simple. Venation (Plate 1, fig. 1): No vestige of Sc_1; Rs long; R_1 beyond free tip of Sc_2 about equal in length to latter; m-cu on M_4 some distance beyond origin of latter; cell 2d A wide. All outer radial veins with macrotrichia; veins M_1, M_2, and M_3 with fewer trichia; M_4 and Cu_1 with these setæ less numerous and scattered.

PRIONOTA NIGRICEPS van der Wulp.

Prionota nigriceps VAN DER WULP, Notes Leyden Mus. 7 (1885) 2, 3.
Prionota nigriceps ALEXANDER, Proc. U. S. Nat. Mus. 49 (1915) 181, 182, pl. 45, fig. 34 (wing); pl. 47, fig. 50 (antenna), figs. 51, 52 (hypopygial details).

Three males, Selabintanah, Mount Gedeh, western Java, altitude 3,000 feet, September, 1935 (*Walsh*). One male, Goenoeng Malang, Djampangs, western Java, altitude 4,000 feet, October, 1936 (*Walsh*).

In these specimens the following differences from van der Wulp's characterization are noted. Antennal scape black, pedicel reddish to brownish black. Petiole of cell M_1 very variable in length, in cases exceeding m, in others the cell narrowly sessile.

PSELLIOPHORA KANGEANENSIS sp. nov. Plate 1, fig. 2.

Head and thorax orange; halteres black; legs black, all tibiæ with a conspicuous subbasal white ring; wings uniformly suffused with black; abdomen with basal three segments orange, remainder, including hypopygium and ovipositor, black.

Male.—Length, about 13 to 15 millimeters; wing, 12 to 14; antenna, 4.5 to 5.

Female.—Length, about 20 to 22 millimeters; wing, 15 to 16.

Frontal prolongation of head orange-yellow, nasus a little darker; palpi with basal two segments dusky, outer segments more yellowish. Antennæ with scape and pedicel reddish brown; flagellum black, incisures of the more basal segments restrictedly pale. Head orange, posterior orbits more yellowish.

Pronotum and mesonotum almost uniformly reddish orange, præscutum subopaque, without clearly defined darker areas; scutum orange, each lobe with two slightly darker areas. Pleura orange, dorsopleural membrane a little more yellowish orange. Halteres black, base of stem narrowly reddish. Legs with coxæ and trochanters orange; femora black, bases restrictedly yellow, narrowest on posterior legs; tibiæ black, all with a narrow but clearly defined and conspicuous white subbasal ring, vestiture of the annulus snowy white; tarsi black. Wings (Plate 1, fig. 2) uniformly suffused with black, stigma and costal portion a little more intense; in the female, cells R and M with pale linear central streaks beyond midlength; veins black. Squama naked, margin immediately beyond it with long dense black setæ. Venation: Cell M_1 narrowly to broadly sessile.

Abdomen with basal three segments orange; remainder of abdomen, excepting posterior border of fourth sternite, black.

Habitat.—Kangean Island (northeast of Java).

Holotype, male, Petapau, March 1936 (*Walsh*). Allotopotype, female, pinned with type. Paratopotypes, 10 males and females; paratypes, 2 males, 1 female, Ardjasa, March 1936 (*Walsh*).

The nearest relative of the present fly is *Pselliophora luctuosa* de Meijere, of western Java, which differs conspicuously in the coloration of the abdomen and in the structure of the male hypopygium.

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

One male, Goenoeng Besser, Djampangs, western Java, May, 1936 (*Walsh*).

PSELLIOPHORA STIGMATICA FLAVOSCUTELLARIS subsp. nov.

Female.—Length, about 16 millimeters; wing, 14.

Differs from typical *stigmatica* de Meijere (Central Nias), as follows: Median præscutal stripe divided by a pale vitta, especially conspicuous on posterior half; dark areas on scutal lobes not confluent across midline; scutellum uniformly yellow, including parascutella; mediotergite not or scarcely darkened on posterior half. Blackened areas on both the anepisternum and ventral sternopleurite. Femora with only the distal fourth or less dark brown; tibiæ brown, white basal rings of the posterior pair much more extensive than those of other legs; tarsi black.

Wings with prearcular field weakly darkened; stigma pale yellow, its proximal end weakly darkened. Venation: Cell M_1 very short-petiolate. Basal abdominal tergites brownish black, their posterior margins yellow; sternites yellow, not or scarcely darkened.

Habitat.—Sumatra (Benkoelen).

Holotype, female, Tanjong Sakti, altitude 1,650 to 2,000 feet, June 11 to 20, 1935 (*Walsh*).

It seems probable that *Pselliophora chaseni* Edwards (Anamba Island, South China Sea) will likewise be found to represent a subspecific group of *stigmatica*. It differs from the present fly by the entire median præscutal stripe, posteriorly darkened mediotergite, and the distinctively patterned legs and wings.

PSELLIOPHORA BIAURANTIA sp. nov. Plate 1, fig. 3.

General coloration black; abdominal segments two and three orange; all tibiæ with a clearly defined white subbasal ring; wings black, variegated by five creamy-yellow areas, including a broken crossband of three areas before cord; cell M_1 sessile.

Female.—Length, about 17 millimeters; wing, 14.

Frontal prolongation of head and nasus black, dorsal surface of former with abundant black setæ; palpi brownish black. Antennæ black, 12-segmented (female); outer flagellar segments depressed, broader than long. Head velvety black.

Mesothorax uniformly black, three præscutal stripes glabrous and faintly nitidous, not otherwise differentiated from remainder of notum. Halteres black. Legs black, all tibiæ with a subbasal white ring, narrow but clearly defined on all legs; posterior femora stout, with inconspicuous setæ, extreme femoral bases pale. Wings (Plate I, fig. 3) black, variegated by five creamy-yellow areas, including a major series of three forming an incomplete crossband before cord, located in cells R_1 and R, outer end of cell M, and outer end of cell Cu, respectively, interrupted by dark seams along veins M and Cu; the two additional creamy areas lie in the base and outer portion of cell 1st A; additional to these primary areas are pale longitudinal streaks in centers of cells R_1, M, M_3, M_4, Cu, and 1st A, these latter presumably a character of the female sex only, as common in the genus; cell 2d A more grayish, its base darker; veins dark brown. A fringe of long setæ on wing margin beyond squama. Venation: R_2 unusually long, erect; cell M_1 sessile.

Abdomen velvety black, with the single exception of segments two and three which are deep orange, lateral borders of tergites slightly darkened, caudal margin of third sternite narrowly brownish black; genital shield and ovipositor polished black; cerci straight, tips narrowly pale.

Habitat.—China (Kwangtung).

Holotype, female, Pi Shan, Yuen Hing Ying, low on mountain, among trees, May 26, 1936 (*Hai Tsz*).

Pselliophora biaurantia is most nearly allied to *P. speciosa* Edwards (Assam) and *P. stabilis* Alexander (Yunnan). These species are all smaller than *P. ctenophorina* Riedel (Formosa) but agree in the uniformly black head and thorax. The present fly differs from *speciosa* in the reduction of the orange on the abdomen and in the conspicuously patterned wings; from *stabilis* it is readily told by the coloration of the legs and abdomen, the increased number of antennal segments, and especially by the pattern of the wings.

PSELLIOPHORA UPSILON sp. nov. Plate 1, fig. 4.

Mesonotal præscutum and pleura yellow, variegated with black, cephalic half of præscutum black, posterior half covered by a U-shaped yellow area before the suture; scutellum yellow; knobs of halteres dark brown; femora black, bases yellow, the amount of the latter greatest on posterior legs; all tibiæ with a narrow, clearly defined, white subbasal ring; wings almost uniformly tinged with brown, stigma darker brown; cell M_1 short-petiolate; abdomen with basal four segments yellow, segments five to eight black; ninth segment (male) chiefly orange-red, blackened at apex.

Male.—Length, 13 to 14 millimeters; wing, 12 to 13; antenna, about 7.

Frontal prolongation of head above light sulphur-yellow, including nasus, infuscated laterally and beneath; palpi pale, distal end of terminal segment more darkened. Antennæ with scape and pedicel obscure yellow; flagellum and branches black, apices of the more basal segments narrowly brightened. Head orange, occiput and postgenæ brownish black.

Pronotum yellow medially, blackened on sides. Mesonotal præscutum with cephalic half, including humeral region, solidly black, the area produced more caudad along the midline, ending at near midlength of sclerite; opposite humeral region the dark color becoming confluent with the black of prothorax; posterior half of præscutum uniformly orange, forming a U-shaped transverse saddle before suture; scutal lobes and suture blackened, median area of scutum and posterior portion of lobes yellow; scutellum testaceous yellow; mediotergite with posterior half and lateral borders black, anterior central portion orange-yellow. Pleura variegated orange-yellow and black, black color including propleura; a large but narrow area on mesosternum, this narrowed to virtually interrupted on dorsal sternopleurite, directly connected with dark color of scutal lobes; posterior half of pleurotergite and entire metapleural region black; dorsopleural region light yellow, excepting darkened end portions as described. Halteres yellow, extreme base of stem and the knobs dark brown. Legs with fore and middle coxæ yellow, hind coxæ blackened, their apical portions yellow; trochanters yellow, darkened apically; femora black, bases yellow, including about proximal third of fore femora, proximal half of midfemora, and proximal two-thirds of hind pair; tibiæ black, all with a clear-cut, narrow, white ring, slightly broader and somewhat more yellowish on posterior tibiæ; tarsi black. Wings (Plate 1, fig. 4) almost uniformly tinged with brown, the prearcular region and small stigma darker brown; veins brownish black. Venation: Cell M_1 petiolate, stem shorter than m.

Abdomen with basal four segments uniformly light yellow to orange-yellow; segments five to eight, inclusive, black; segment nine cylindrical, orange-red, apex including styli blackened.

Habitat.—Eastern Java.

Holotype, male, Baoeng Falls, Tengger Mountains, altitude 1,200 feet, February, 1936 (*Walsh*). Paratopotypes, 2 males.

By various keys to the species of *Psellíophora* the present fly runs to *P. fuscipennis* (Macquart), which differs notably in the coloration of the body and wings. The transverse yellow saddle of the present fly, involving the entire posterior half of the præscutum, is very conspicuous, and the pattern of the abdomen is similarly distinctive.

LONGURIO (LONGURIO) FULVUS Edwards.

Longurio fulvus EDWARDS, Ann. & Mag. Nat. Hist. 8 (1916) 262.

The types, females, were from northern China. I have before me a few specimens representing both sexes. In this material the orange color of the body is very bright and intense, more so than in material from Kiangsi Province and from Formosa. The present specimens were taken in Kwangtung

Province, southeastern China, by Mr. Hai Tsz, native collector for Mr. Tinkham.

Sui Hit Chi, Cow Bo Shan, Yue Hing Ying, on mountain grass, altitude over 1,000 feet, May 31, 1936. Ping Shan, Yue Hing Ying, June 5, 1936. Gee To Wa, June 7, 1936.

TIPULA (TIPULODINA) AMABILIS sp. nov. Plate 1, fig. 5.

Belongs to the *venusta* group; allied to *gracillima*; mesonotal præscutum with stripes confluent, scarcely differentiated from ground color; an incomplete, dark brown, transverse girdle extending from lateral ends of præscutal stripes across dorsopleural membrane onto dorsal sternopleurite; Rs short, transverse; R_{1+2} atrophied; R_3 long, deflected strongly toward wing tip.

Female.—Length, about 23 millimeters; wing, 15.5.

Frontal prolongation of head whitish above, blackened on sides and beneath; nasus elongate, white; basal segments of palpi dark brown, two distal segments paler, outer one darkened at apex. Antennæ with scape pale at base, darkened apically; pedicel dark brown; flagellum black, segments cylindrical, with verticils shorter than segments; terminal segment about two-thirds length of penultimate. Front and anterior vertex whitish; posterior vertex and occiput infuscated, with a capillary black median vitta extending from anterior vertex almost to occiput.

Pronotum dark brown medially, abruptly whitened on sides. Mesonotal præscutum almost covered by dark brown, the usual interspaces virtually concolorous with the stripes, the latter delimited by a slightly darker median vitta and by vague margins to the lateral stripes; a dark area opposite anterior end of lateral stripe, crossing the dorsopleural membrane and extending as a narrow incomplete girdle across the anepisternum onto sternopleurite; humeral triangle of præscutum abruptly light yellow; sides of præscutum before suture a little brightened; scutum dark brown; scutellum a little paler, parascutella dark; mediotergite pale brown, the posterior border and a central stem darker to form an inverted T-shaped area. Pleura pale yellow, variegated with brown, as described above; pleurotergite weakly infumed except at summit of tubercle. Halteres long and slender, black, base of stem restrictedly pale. Legs with coxæ whitened; trochanters white, with a dark spot on inner face at apex; fore and midle femora black, more yellowish basally, darker outwardly, with a narrow (1.3 millimeters) white ring immediately before the very narrow blackened apex; hind femora brown, tips deepening to black; fore and middle tibiæ black, with a relatively broad (2 millimeters) white ring at tip; hind tibiæ black, with a moderately broad (3 millimeters) white ring beyond base and another wider (4 millimeters) annulus at tip; fore and middle basitarsi black, tips narrowly (about the distal sixth or less) snowy white; posterior basitarsi black with about the outer three-fifths abruptly white; remaining tarsal segments white. Wings (Plate 1, fig. 5) subhyaline, with a very delicate yellowish tinge; stigma and a confluent seam on anterior cord brownish black; wing tip, in cells Sc_2 to R_5 inclusive, darkened, the area barely involving the cephalic margin of cell M_1; in cells R_3 and R_5 centers of darkened portions a little paler; cell Sc black; veins black, very distinct. Venation: R_{1+2} atrophied, so cells Sc_2 and R_2 are confluent; Rs very short, subequal to r-m and nearly in transverse alignment with the other elements of anterior cord; vein R_3 long, deflected strongly toward wing apex; cell 2d A moderately wide.

Abdominal tergites brown, variegated with more yellowish areas on basal rings before apices of segments; sternites more uniformly brownish yellow.

Habitat.—Western Java.

Holotype, female, Goenoeng Malang, Djampangs, altitude 4,000 feet, October, 1936 (*Walsh*).

Tipula (*Tipulodina*) *amabilis* is most closely allied to *T.* (*T.*) *gracillima* Brunetti, of southern India and Ceylon, differing in the coloration of the body and legs, and in the details of venation. In the present fly vein R_3 is shorter and more distant from the costal border than in *gracillima*. Both species have vein R_{1+2} atrophied, either wholly or except for a rudimentary basal spur.

TIPULA (VESTIPLEX) NOKONIS Alexander.

Tipula nokonis ALEXANDER, Philip. Journ. Sci. 36 (1928) 459-461.

The type, a male, was from Noko, Formosa, altitude 9,800 feet, collected June 27, 1927, by Issiki. A female specimen that surely seems to be conspecific is now available.

Female.—Length, about 22 millimeters; wing, 18.

Characters as in male, with the following differences: Palpi black. Antennæ with scape brownish black, pedicel light yellow; flagellum entirely black. Vertex of head chiefly dark brown, front more grayish; vertical tubercle low and entire. Ground color of mesonotum clearer gray than greenish gray. Femora obscure yellow, tips blackened, without a clearly-defined subterminal yellow ring. Ovipositor with cerci strongly compressed, margins entirely smooth; hypovalvæ relatively short, not exceeding caudal end of genital shield.

Allotype, female, Kwanzan, Formosa, altitude 9,000 feet, June 30, 1936 (*R. Takahashi*).

TIPULA (VESTIPLEX) TAKAHASHIANA sp. nov. Plate 1, fig. 6.

Size small (wing, female, 9 millimeters); general coloration of thorax dark brown, præscutum with four narrow black stripes; antennal scape and pedicel light yellow, flagellum black, halteres dark brown, base of stem narrowly obscure yellow; femora black, with a narrow yellow subterminal ring; wings brown, vaguely brightened by more yellowish areas; Rs about twice length of m-cu; cerci yellow, margins entire.

Female.—Length, about 12.5 millimeters; wing, 9.

Frontal prolongation of head yellow above, blackened on sides and beneath; nasus distinct; palpi black. Antennæ with the scape and pedicel light yellow, flagellum black; flagellum with some of the segments fused, including the basal two and the apical pair; segments short-cylindrical, simple, with verticils that exceed the segments in length. Front and anterior vertex golden-yellow, with a narrow capillary dark vitta extending from summit of the simple vertical tubercle to occiput; sides of posterior vertex and genæ infuscated.

Pronotum brownish black. Mesonotal præscutum dark brown, with four narrow black stripes, intermediate pair connected in front, convergent behind, apparently representing darkened borders of a median stripe; long yellow setæ on præscutal interspaces; posterior sclerites of notum brown. Pleural, including dorsopleural membrane, dark brown. Halteres dark brown, base of stem narrowly obscure yellow. Legs with coxæ dark brown; trochanters yellow; femora black, base of fore femora narrowly yellow; all femora with a narrow but conspicuous subterminal yellow ring placed a little more than its own length from tip; tibiæ testaceous-brown, tips narrowly darkened; tarsi black. Wings (Plate 1, fig. 6) relatively small and narrow, but not showing indications of degeneration of venation; ground color brown, vaguely brightened by more yellow areas, including the prearcular field; a common mark near bases of cells M to 2d A, inclusive; small spots before and beyond origin of Rs; a poststigmal brightening in cells R_2 and R_3; conspicuous, more whitish, obliterative areas before stigma and across base of cell 1st M_2; veins brown. Venation: Rs relatively long, about twice m-cu; cell 1st M_2 relatively large, its inner end pointed; petiole of cell M_1 shorter than m; cell 2d A narrow.

Abdomen reddish brown, the tergites more blackened medially; subterminal segments more uniformly blackened. Cerci yellow, with entire margins; hypovalvæ very reduced, black.

Habitat.—Formosa.

Holotype, female, Hattsukan, altitude 9,000 feet, August 23, 1936 (*Takahashi*).

I take unusual pleasure in naming this interesting *Tipula* in honor of the collector, my long-time friend, Professor Ryoichi Takahashi, to whom I express my deep indebtedness for many favors in connection with a study of the Tipulidæ of the Japanese Empire. The species is very distinct from the other regional species of the genus in size, in the coloration of the body, wings, and legs, and in the entire cerci. *Tipula* (*Vestiplex*) *deserrata* Alexander, of western China, and *T.* (*V.*) *nokonis* Alexander, of Formosa, have similar entire cerci, but in all other regards are quite distinct flies. The condition of having the cerci untoothed appears to be more common in *Vestiplex* than had hitherto been believed.

TIPULA (VESTIPLEX) BICORNIGERA sp. nov. Plate 2, figs. 26 and 27.

Allied to *bicornuta;* general coloration yellow, præscutum with four brown, unmargined stripes; antennæ (male) relatively elongate, flagellum black; knobs of halteres dark brown; femora obscure brownish yellow, tips narrowly black, preceded by a clearer yellow ring; wings pale brown, variegated by slightly darker brown and cream-colored areas; male hypopygium with tergite produced into a median plate that divides into two yellow divergent lobes that are set with strong black setæ; basistyle produced into a nearly straight black spine; inner dististyle a compressed high blade.

Male.—Length, about 11 millimeters; wing, 12.5; antenna, about 5.

Frontal prolongation of head light yellow, slightly darker on sides; nasus slender; palpi brownish black. Antennæ (male) relatively elongate, as shown by the measurements; scape and pedicel light yellow; first flagellar segment brown, narrowed outwardly; remainder of flagellum black; flagellar segments with moderately large basal enlargements; verticils long but still somewhat shorter than segments; terminal segment about one-fourth length of penultimate. Head yellow, with a narrow brown median vitta; vertical tubercle small and low.

Pronotum dark medially, golden-yellow pollinose. Mesonotal præscutum with ground color golden pollinose, with four brown stripes, intermediate pair entirely confluent at extreme cephalic portion, narrowly separated on posterior two-thirds; posterior interspaces with small dark triangles just before suture; setæ of interspaces small, yellow; scutum yellow, each lobe with two brown areas, median region with a capillary dark vitta that continues almost unbroken over central area of scutellum and mediotergite. Pleura yellow. Halteres with stem obscure yellow, knob dark brown. Legs with coxæ and trochanters yellow; femora obscure brownish yellow, tips rather narrowly (about 1 millimeter) black, extreme tip a trifle paler, black areas subequal in length on all legs; black femoral apices preceded by a clearer yellow subterminal ring of approximately equal length; tibiæ and tarsi black. Wings pale brown, variegated by slightly darker brown and cream-yellow areas; prearcular region and cell C uniformly yellow, cell Sc a trifle more infuscated on basal half; dark areas including stigma and a confluent seam on anterior cord and another area at origin of Rs; cream markings involving cells before cord, as well as a narrow, incomplete, poststigmal area from C into cell R_5, nearly reaching obliterative mark across cell 1st M_2; outer radial and medial cells almost uniformly pale brown, not or scarcely variegated; veins brown, a little paler in the more yellowish areas. Venation: Rs a little more than twice m-cu; R_3 nearly straight, not markedly upcurved on distal portion (as in *biserra*), cell R_3 at margin thus much more extensive than cell R_4; petiole of cell M_1 a little longer than m; cell 1st M_2 pentagonal in outline, its outer end only moderately pointed; m-cu shortly before fork of M_{3+4}.

Abdominal tergites yellow, trivittate with darker, including a more clearly defined; nearly continuous, median stripe and paler brown submarginal stripes, extreme borders pruinose; outer segments uniformly darkened; basal sternites yellow. Male hypopygium somewhat as in *bicornuta* but with the details very different. Ninth tergite (Plate 2, fig. 26, 9*t*) with the median area produced caudad into a flattened yellow plate that forks into two divergent lobes set with short blackened setæ that are directed outward; dorsal lateral angles of tergite produced into small black lobes that are tipped with a few setæ; posterior or cephalic portions of tergal saucer blackened and microscopically roughened, saucer divided at midwidth by pale membrane. Basistyle (Plate 2, fig. 27, *b*) bearing a powerful black spine, nearly straight, tip obtuse. Outer dististyle a dusky, flattened-clavate lobe. Inner dististyle (Plate 2, fig. 27, *id)* much deeper than in *bicornuta*, stem portion near base bearing a conspicuous black spine. Eighth sternite simple, unmodified by lobes, and with very few setæ.

Habitat.—Formosa.

Holotype, male, Oiwake, Noko-gun, altitude 7,570 feet, August 12, 1936 (*Takahashi*).

The nearest ally of the present fly is undoubtedly *Tipula (Vestiplex) bicornuta* Alexander, likewise from the high mountains of Formosa. The latter species is a trifle larger, with bicolorous antennal flagellum, shorter Rs, and a very differently constructed male hypopygium, the distinctions in the latter, including the tergite, the spine of the basistyle, and especially the inner dististyle which is narrow and drawn out into a long apical beak.

TIPULA (OREOMYZA) NIITAKENSIS sp. nov. Plate 1, fig. 7; Plate 2, figs. 25 to 30.

General coloration of mesonotum olive-gray, præscutum with four darker stripes; antennal flagellum uniformly black; femora obscure yellow, tips narrowly blackened; wings pale brown, variegated with numerous, small, cream-colored areas distributed over surface; cell M_1 narrowly sessile; abdominal tergites trivittate with brownish black, median stripe entire; outer abdominal segments uniformly darkened; male hypopygium with tergite deeply emarginate, lateral lobes slender, pale, provided with setæ to their tips; eighth sternite unmodified.

Male.—Length, about 14 millimeters; wing, 16; antenna, about 4.2.

Frontal prolongation of head grayish brown; nasus slender; palpi brownish black. Antennæ with scape and pedicel yellow; flagellum black; flagellar segments weakly incised; longest verticils subequal in length to segments; terminal segment nearly one-third length of penultimate. Head brownish gray, front and vertical tubercle light yellow; a capillary median vitta from summit of vertical tubercle backward, becoming nearly obsolete on posterior vertex.

Pronotum olive-brown, darker in front. Mesonotal præscutum olive-gray, with four darker stripes, intermediate pair darker brown, separated by a very indistinct gray median vitta, their margins narrowly and insensibly bordered by darker; lateral stripes more grayish brown, mesal edge darker; scutum olive-gray, each lobe with two confluent brown areas; median area of suture and posterior sclerites of mesonotum olive-gray, with a nearly continuous brown median vitta. Pleura chiefly olive-gray, yellowish sericeous. Halteres with stem brownish yellow, knob dark brown with paler apex. Legs with coxæ olive-yellow; trochanters yellow; femora obscure yellow, tips rather narrowly (2 millimeters) blackened, the amount subequal on all legs, this tip preceded by a vague, clearer yellow, subterminal ring; tibiæ brownish yellow, tips narrowly brownish black; tarsi brownish black. Wings (Plate 1, fig. 7) with ground color pale brown, variegated by numerous small cream-colored areas, distributed over surface, larger in basal cells; pale areas before and beyond origin of Rs; an incomplete post-stigmal yellow band in cells Sc_2 to R_5, inclusive; a conspicuous, more whitish spot in cell 1st M_2 and the adjoining portion of cells M_3 and M_4; outer medial cells uniformly darkened; cell 2d A pale at both ends; cells C and Sc uniformly yellow; veins brown, a little paler in the brightened areas. Venation: R_{1+2} entire; cell M_1 narrowly sessile or microscopically petiolate; cell 2d A of moderate width.

Abdomen yellow, tergites trivittate with brownish black; median stripe entire, on sixth to ninth segments involving entire sclerites; lateral stripes paler, margins of segments narrowly gray; sternites yellow, terminal segments blackened. Male hypopygium (Plate 2, fig. 28) of moderate size; tergite, *9t*, only indistinctly separated from sternite by pale membrane; basistyle entirely distinct. Ninth tergite (Plate 2, fig. 29, *9t*) with a very deep V-shaped notch, so the sclerite at midlength is very narrow; lateral angles produced into slender pale lobes, clothed with setæ to their tips; on ventral surface on either side a blackened expanded lobe, its apical margin microscopically serrulate. Outer dististyle (Plate 2, fig. 30, *od*) elongate, distal half expanded into a narrow blade. Inner dististyle (Plate 2, fig. 30, *id*) with the apical beak slender, simple, blackened; from its base a long flattened ribbonlike blade, apex obtuse, provided with a few long setæ. Eighth sternite (Plate 2, fig. 28, *8s*) not produced, its margin pale and unmodified by lobes or setæ; near base, on either side of midline, with a transverse linear pale line.

Habitat.—Formosa.

Holotype, male, Mount Niitaka, August 25, 1936 (*Takahashi*).

Tipula (*Oreomyza*) *niitakensis* is quite distinct from other regional species of the subgenus in the sessile cell M_1 and in the structure of the male hypopygium, especially the ninth tergite and styli. This is another species that may well be better placed in the subgenus *Vestiplex* Bezzi. A list of the critical species that may with almost equal propriety be placed in *Oreomyza* or *Vestiplex* has been provided in another paper of this series.[6]

TIPULA (OREOMYZA) TRIDENTATA Alexander.

Tipula tridentata ALEXANDER, Ann. Ent. Soc. America 13 (1920) 265, 266.

Tipula (Oreomyza) tridentata ALEXANDER, Philip. Journ. Sci. 57 (1935) 123.

The type locality was Musha, Formosa, altitude about 3,700 feet, May 18 to June 15, 1919. Additional Formosan records are: Arisan, altitude 8,000 feet, August 26, 1936 (*Takahashi*). Mount Gokwan, altitude 10,000 feet, August 12, 1936 (*Takahashi*).

In this species there is considerable variation in the coloration of the antennal scape and in the relative width of the yellow subterminal femoral rings.

NEPHROTOMA NIGROCENTRALIS sp. nov. Plate 2, figs. 31 and 32.

General coloration sulphur-yellow and black; antennæ (male) relatively long, flagellum black; orbits with dark spots; præscutum with three polished black stripes that are narrowly bordered by velvety black; lateral stripes straight, crossing suture onto scutal lobes; scutellum black; mediotergite clear yellow, its posterior fourth blackened; knobs of halteres sulphur yellow; fore femora pale at both ends, with nearly the central half black; wings whitish subhyaline, stigma, cells Sc and Cu_1, and a seam along vein Cu in cell M dark; no stigmal trichia; subterminal abdominal segments blackened; hypopygium orange; male hypopygium with the lateral tergal lobes broad; eighth sternite without modified setæ.

Male.—Length, about 12 millimeters; wing, 10; antenna, about 5.

Frontal prolongation of head yellow, blackened laterally and beneath and with a narrow black dorsal area that includes the nasus; palpi brownish black. Antennæ (male) relatively long, as shown by measurements; scape and pedicel obscure yellow, flagellum black; flagellar segments strongly incised; longest verticils much shorter than segments. Head orange; posterior orbits with a large velvety black area on either side, directly behind antennal bases; occipital brand triangular, its anterior point acute but not reaching base of vertical tubercle.

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[6] Philip. Journ. Sci. 57 (1935) 118.

Pronotum broadly yellow medially, blackened on sides. Mesonotal præscutum light yellow, with three polished black stripes that are very narrowly bordered by more velvety black, posterior interspaces reduced to narrow lines; lateral stripes nearly straight, velvety border at their anterior end a trifle expanded but scarcely outcurved; scutum yellow, centers of lobes black, connected across suture with lateral præscutal stripes, and further confluent behind with polished black scutellum; parascutella weakly infumed; mediotergite clear sulphur-yellow, posterior fourth blackened, with sparse pale setæ only. Pleura sulphur-yellow, including dorsopleural membrane, variegated with black on anepisternum, dorsal pteropleurite and posterior pleurotergite; ventral sternopleurite and meron more reddish. Halteres with stem black, knob light sulphur-yellow. Legs with coxæ obscure yellow, fore and hind coxæ narrowly blackened at bases; trochanters yellow; fore femora with base and apex yellow (about 2 millimeters), leaving central portion more broadly (about 3.5 millimeters) black; remaining femora obscure yellow, tips very narrowly blackened; tibiæ yellowish brown, tips narrowly blackened; tarsi black. Wings whitish subhyaline; stigma and cell Sc blackened; a dusky seam in cell M adjoining vein Cu; cell Cu_1 darkened; veins black. Stigma without trichia, except that in one wing of type there is a single one on the extreme border of proximal end, the character undoubtedly being variable. Venation: Sc_1 persistent as a spur; Sc_2 opposite origin of Rs, latter in oblique alignment with basal section of R_{4+5}; cell 1st M_2 small; cell M_1 narrowly sessile; m-cu on M_4 just beyond origin, latter a corresponding distance from fork of M_3.

Abdomen black, segments two to five, inclusive, with bases broadly yellow, the amount of the latter including more than basal half of segment, less extensive on segment five; subterminal segments black; hypopygium orange. Male hypopygium with caudal margin of tergite (Plate 2, fig. 31, *9t*) bearing a very deep and narrow median incision, adjoining lobes with abundant black spinous points; lateral angles of tergite produced into broader and more truncated lobes that bear an apical group of similar spines, lateral and intermediate lobes separated by a U-shaped notch above and an obtuse sclerotized flange below. Outer dististyle (Plate 2, fig. 32, *od*) relatively broad, produced apically into a cylindrical lobe. Inner dististyle (Plate 2, fig. 32, *id*) simple, apical beak slender. Median region of ninth sternite produced ventrad into a small conical pale point. Eighth sternite extensive, caudal portion with a U-shaped median incision filled with pale membrane, lateral apical portions paling to yellow and without setæ. Gonapophyses small and pale, apical blade in slide mounts appearing twisted and crumpled.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Mocara Tenam, June 16 to 23, 1935 (Walsh).

The most similar described species is *Nephrotoma medipubera* Edwards, of eastern Java, which has the fore femora somewhat similarly patterned, but differs in other details of coloration of the body, in the details of venation, and in the presence of dense setæ on the postnotal mediotergite.

NEPHROTOMA PALLIDAPEX sp. nov. Plate 1, fig. 6; Plate 2, figs. 33 and 34.

General coloration yellow, with black markings; frontal prolongation of head black; antennal flagellum black; no differentiated occipital brand; præscutal stripes polished black, narrowly bordered by more velvety black; scutellum yellow; knobs of halteres clear yellow; legs black, femoral bases obscure yellow; wings with cells basad of cord weakly tinted with brown, those beyond cord clear gray; stigma oval, brown; cell Sc darkened; outer abdominal segments, including hypopygium, black.

Male.—Length, about 12 millimeters; wing, 10.5; antenna, about 3.5.

Frontal prolongation of head, including nasus, entirely black; palpi black. Antennæ relatively short, as shown by the measurements; scape and pedicel obscure yellowish brown, flagellum black; flagellar segments strongly incised; longest verticils a little shorter than segments. Front and anterior vertex sulphur-yellow, posterior vertex more orange; a small darker orange-brown spot near posterior orbits, behind antennal bases, not touching the eye margin; posterior genæ conspicuously brownish black, more pruinose on ventral portions; no differentiated occipital brand.

Pronotum yellow medially, blackened on sides. Mesonotal præscutum sulphur-yellow, with three polished black stripes that are narrowly bordered by more velvety black; posterior interspaces relatively wide; lateral stripes straight but with a faint darker cloud opposite their anterior ends; scutum yellow, lobes chiefly covered by confluent polished black areas that are narrowly bordered by velvety black, very narrowly separated at suture from lateral præscutal stripes; scutellum yellow, parascutella infuscated on central portion; mediotergite yellow, broad, central portion of posterior third darkened; a few long coarse black setæ at posterolateral portions of mediotergite. Pleura yellow, variegated by black on propleura; anepisternum, this including a narrow border adjoining the pteropleurite in addition to major darkened portion lying more cephalad; ventral sternopleurite and meron; dorsal and posterior portions of pleurotergite. Halteres obscure yellow, knobs clear sulphur-yellow. Legs with coxæ black, with abundant long white setæ; trochanters brown; femora black, basal third or less obscure yellow; tibiæ and tarsi black. Wings (Plate 1, fig. 8) with cells basad of cord weakly tinted with brown, those beyond cord abruptly clear gray; stigma oval, brown, cell Sc uniformly darkened; veins dark brown. Stigmal trichia about five. Venation: Sc_1 present; Sc_2 extending to just beyond origin of Rs, the latter longer than basal section of R_{4+5}; cell M_1 narrowly sessile; veins M_3 and M_4 arising at fork of M, m-cu just beyond origin of latter.

First abdominal tergite velvety black; tergites two to four, inclusive, obscure yellow, posterior margins with low black triangles, the points directed forward; basal sternites uniformly pale; segments five to nine, including hypopygium, black. Male hypopygium of unique type, with tergite accidentally lost in dissecting. Outer dististyle (Plate 2, fig. 33, *od*) moderately attenuated. Inner dististyle (Plate 2, fig. 34, *id*) with beak stout, disc of style set with coarse black retrorse setæ. Ninth sternite with a median pale lobe, directed ventrad, lying in notch of extensive, feebly emarginate eighth sternite.

Habitat.—Sumatra (Benkoelen).

Holotype, male, Boekit Jtam, altitude 1,000 to 2,000 feet, June 11 to 15, 1935 (*Walsh*).

Nephrotoma pallidapex is readily told from all allied regional species by the peculiar pattern of the wings. From other forms with the frontal prolongation of the head black and with undifferentiated occipital brand, as *N. nigrirostris* Edwards (Pahang), it differs evidently in the coloration of the body and wings.

DOLICHOPEZA (DOLICHOPEZA) KATOI sp. nov. Plate 1, fig. 9; Plate 2, fig. 35.

Mesonotal præscutum and scutum darkened; thoracic pleura uniformly pale yellow; femora yellow, tips narrowly blackened; all tarsi snowy white; wings with a strong brown tinge, stigma slightly darker; Rs short and transverse; medial forks of moderate depth; male hypopygium with caudal margin of tergite trilobed, median lobe obtuse.

Male.—Length, about 14 millimeters; wing, 13.5; antenna, about 5.5.

Frontal prolongation of head brownish black; palpi black. Antennæ with basal three segments pale yellow, remainder of flagellum black, incisures of more basal segments narrowly pale; flagellar segments long-cylindrical, without developed basal swellings; verticils shorter than segments. Head brownish black, silvery pruinose in front.

Pronotum brownish black, paler laterally. Mesonotal præscutum and scutum almost uniformly polished brownish black, the former paler laterally; scutellum and mediotergite more brownish testaceous. Pleura and pleurotergite uniformly pale yellow. Halteres elongate, stem obscure yellow, knob infuscated. Legs with coxæ and trochanters pale yellow; femora yellow, tips narrowly brownish black, the amount subequal on all legs; tibiæ obscure yellow, tips very narrowly darkened; tarsi snowy white. Wings (Plate 1, fig. 9) with a strong brown tinge, cell Sc more yellowish; stigma pale brown; indistinct pale brown seams on m-cu and distal section of Cu_1; obliterative areas before and beyond stigma and at *r-m* small but conspicuous; veins brownish black, paler in costal portion. Macrotrichia of veins abundant but relatively small and delicate. Venation: Sc_2 ending a short distance before transverse, entirely pale Rs; free tip of Sc_2 some distance before R_2, R_1 thus preserved, with about ten trichia; medial forks of moderate length; cell 2d A relatively wide.

Abdominal tergites almost uniformly brown, the outer segments and hypopygium more brownish black, lateral borders of segments obscure yellow; sternites yellow. Male hypopygium (Plate 2, fig. 35) with caudal margin of tergite, *9t*, trilobed, median lobe obtuse. Outer dististyle a small, elongate, pale lobe. Inner dististyle, *id*, powerful, oval in outline, margin of apical portion blackened. What appears to be a lobe from the sternite, *8s*, is long and slender, a little expanded and weakly bilobed at apex, entire surface with abundant pale setæ.

Habitat.—Japan (Honshiu).

Holotype, male, Yamagawa, Iwate, June 7, 1936 (*Kato*); collector's No. 15.

I take great pleasure in naming this fly in honor of the collector, Mr. Takeo Kato. The only other described species of the subgenus in eastern Asia is *Dolichopeza (Dolichopeza) issikiella* Alexander, of southern Formosa, an entirely different fly. The present insect is one of the most distinct species of the genus so far discovered.

DOLICHOPEZA (NESOPEZA) THISBE sp. nov. Plate 1, fig. 10; Plate 2, fig. 34.

General coloration testaceous yellow, præscutum with three dark brown stripes, median area divided by a paler median vitta; antennal flagellum brown; wings whitish subhyaline, heavily patterned with brown, markings much broken and less extensive than ground color; R_{1+2} entirely atrophied; medial forks short.

Male.—Length, about 9 millimeters; wing, 9; antenna, about 3.5.

Frontal prolongation of head brownish black; palpi black, outer end of terminal segment paling to whitish. Antennæ relatively long, if bent backward extending about to base of abdomen; scape and pedicel pale; flagellum pale basally, passing into brown; flagellar segments cylindrical, with short abundant setæ and a single long verticil on each segment, placed beyond midlength, this bristle shorter than segment; terminal segment long-oval, a little more than one-third length of penultimate. Head dark; eyes large, reducing extent of vertex.

Pronotum dark brown, posterior margin paler. Mesonotal præscutum with ground color testaceous-yellow, with three brown stripes, median stripe divided for all but its anterior portion by a pale vitta; lateral stripes entire, their lateral portion produced to border of sclerite but a little paler than the stripe itself; scutum pale, lobes variegated by darker; scutellum chiefly darkened; mediotergite pale, somewhat darker medially. Pleura dark brown, variegated with paler yellowish brown on pteropleurite and pleurotergite. Halteres elongate, stem pale yellow, knob dark brown. Legs with fore coxæ dark brown, midcoxa slightly darkened at base, posterior coxæ pale; trochanters pale yellow; femora dirty white, tips rather narrowly (0.5 millimeter) dark brown, the amount about equal on all legs; tibiæ white, tips very narrowly but conspicuously black, middle and hind tibiæ faintly darkened on basal half, just beyond the narrow, pure white bases; tarsi white. Wings (Plate 1, fig. 10) whitish subhyaline, heavily patterned with brown, markings arranged much as in *titania* but more broken, ground color exceeding in area the brown pattern; in *titania* the ground color is grayish subhyaline, each dark area being narrowly bordered by whitish, whereas in the present fly there are no such pale margins to the brown markings; prearcular field uniformly darkened; veins dark. Venation: Sc long, Sc_2 ending opposite fork of Rs, the latter long, spurred near origin; vein R_1 beyond free tip of Sc_2 bending into R_{2+3}, with no trace of vein R_{1+2}; medial forks shallow; m-cu less than its own length before fork of M.

Abdominal tergites brown, paler laterally; sternites more uniformly yellow, with vague transverse dark clouds or bands; hypopygium dark. Male hypopygium (Plate 2, fig. 36) small and of simple construction. Ninth tergite, *9t*, with the caudal margin blackened and sclerotized, median region a little produced into a low obtuse lobe; lateral portions of tergite more expanded, lateral ends with about six small blackened conical spines. Outer dististyle, *od*, small, long-oval, with about fifteen long setæ. Inner dististyle, *id*, with apex of apical beak truncated. Eighth sternite small, unmodified except medially where there is a small emargination in which the ædeagus lies in a position of rest.

Habitat.—Western Java.

Holotype, male, Goenoeng Tjimerang, Djampangs, altitude 2,100 feet, April, 1936 (*Walsh*).

The nearest relative of the present fly is *Dolichopeza* (*Nesopeza*) *titania* (Alexander) of Sumatra[3] which has the same general coloration of the body, wings, and legs, and with the venation very similar. The present fly differs especially in the more dissected dark wing pattern and the very different ground color, the brown markings not being bordered by whitish and thus producing a very different effect. The wings of *thisbe* are shorter and slightly wider than in *titania*, with the proportions of the cells correspondingly modified; vein R_3 is shorter and more arcuated, while Rs is distinctly short, being less than the distal section of R_{4+5}.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) FUSCICEPS NIGRICUSPIS subsp. nov.

Male.—Length, about 8.5 millimeters; wing, 10.

Characters as in typical *fusciceps* Alexander (Hokkaido, Honshiu), differing especially in the details of the male hypopygium.

Male hypopygium with mesal apical lobe of gonapophysis stout, gently curved, heavily blackened. In the typical form these lobes are slender, weakly darkened, the tips acute or subacute, the concave margin with a low, erose flange.

Habitat.—Japan (Honshiu).

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[3] Supplementa Entomol. 15 (1927) 92, 93, fig.

Holotype, male, Matsuo, Iwate, altitude 3,250 feet, May 31, 1936 (*Yamamoto*).

DICRANOPTYCHA STYGIPES sp. nov. Plate 1, fig. 11.

General coloration gray, præscutum with four scarcely indicated darker gray stripes; legs black, femoral bases yellow, narrowest on forelegs.

Female.—Length, about 12 millimeters; wing, 11.5.

Rostrum gray pruinose; palpi black. Antennæ with scape dark brown, pruinose; pedicel brownish yellow, flagellum black; flagellar segments oval to long-oval, ends truncated; verticils about one and one-half as long as segments. Head gray.

Thoracic dorsum gray, præscutum with four scarcely indicated darker gray stripes, anterior ends of intermediate pair obsolete. Pleura gray. Halteres pale yellow. Legs with coxæ pale, surface sparsely pruinose, most distinct on fore pair; trochanters obscure yellow; femora black, bases yellow, narrowest on forelegs where about the proximal sixth is involved, broader on middle and hind femora, on the latter including about the basal third; tibiæ and tarsi black. Wings (Plate 1, fig. 11) with a strong brownish yellow tinge, prearcular and costal regions clearer yellow; veins beyond cord brown, those basad of cord and in costal field more yellowish. Venation: Cell 1st M_2 about as lond as vein M_4 beyond it; m-cu at or shortly before midlength of cell.

Abdomen black, surface sparsely pruinose; genital shield black, cerci and hypovalvæ horn-yellow to yellowish brown, tips of cerci darker.

Habitat.—Japan (Honshiu).

Holotype, female, Matsuo, Iwate, altitude 2,600 feet, June 14, 1936 (*Yamamoto*). Paratopotype, female, altitude 3,250 feet, June 21, 1936.

Dicranoptycha stygipes is most closely allied to *D. yamata* Alexander, which has the legs differently colored, the tibiæ and basitarsi being light brown to yellowish brown with the tips narrowly infuscated. The latter species further differs in having the wings longer and narrower, with the inner end of cell 1st M_2 but little arcuated and with m-cu closer to the fork of M.

PROTOHELIUS TINKHAMI sp. nov.[1] Plate 1, fig. 12; Plate 3, fig. 37.

General coloration ferruginous-yellow; antennæ (male) elongate, if bent backward extending about to base of abdomen;

legs yellow; wings relatively narrow, grayish yellow, clearer yellow in the prearcular and costal fields; stigma small, oval, pale brown; abdomen, including hypopygium, brownish yellow.

Male.—Length, 7 to 8 millimeters; wing, 7 to 8; antenna, 3 to 3.3.

Female.—Length, 9.5 to 10 millimeters; wing, 8 to 8.2.

Rostrum brownish yellow; basal two segments of palpus obscure yellow, outer segments black. Antennæ (male) relatively elongate, if bent backward extending about to base of abdomen; scape, pedicel, and basal three or four flagellar segments yellow, outer segments passing into brown; flagellar segments long-oval to subcylindrical, with a short dense pubescence; longest verticils about as long as segments. Head gray pruinose over a brown ground; eyes (male) large and protuberant; anterior vertex relatively wide, more than twice diameter of scape.

Thorax entirely ferruginous-yellow, unmarked, except that in some cases the præscutum is a trifle more brownish yellow. Halteres pale, knobs weakly darkened. Legs with coxæ and trochanters ferruginous-yellow; remainder of legs yellow, terminal tarsal segments darkened. Wings (Plate 1, fig. 12) relatively narrow, grayish yellow, prearcular and costal areas clear luteous; stigma small, oval, pale brown; veins brown, yellow in luteous areas. Venation: Sc_2 varying from just before to about opposite fork of Rs; distance on C between Sc_1, free tip of Sc_2, and R_{1+2} subequal; R_{2+3} and R_{1+3} subequal; inner end of cell 1st M_2 strongly arcuated; m-cu variable in position, from shortly before to just beyond fork of M.

Abdomen, including hypopygium, brownish yellow. Male hypopygium (Plate 3, fig. 37) with the two dististyles of generally similar form, as in the genus, the outer one, *od*, glabrous and blackened, the inner style, *id*, pale, with both lobes stouter and provided with erect setæ. Ovipositor with the valves long and slender.

Habitat.—China (Kwangtung, Kiangsi).

Holotype, male, Loh Fau Shan, near Wa Shan Tói Monastery, Kwangtung, altitude about 1,000 feet, April 27, 1936 (*Tinkham*). Allotopotype, female, pinned with type. Paratopotypes, 1 male, 2 females. Paratype, male, Hong San, southeastern Kiangsi, altitude 1,500 feet, July 16, 1936 (*Gressitt*).

Protohelius tinkhami is respectfully dedicated to the collector, Mr. Ernest R. Tinkham, to whom I express my thanks for coöperation in studying the Tipulidæ of eastern China. The only other species so far made known is the genotype, *P. issikii* Alexander, of Formosa, which differs conspicuously in the much larger size, the blackened mesonotum, the broad grayish brown wings with a distinct stigmal area, and in other characters.

The exact affinities of *Protohelius* still remain in question. As indicated at the time of the original defining of the genus,[4] the group is of extreme importance in that it clearly indicates how the more reduced venation of the subtribe *Heliaria* has been brought about. Furthermore, the general structure of the male hypopygium and the venation of the medial field of the wing is strongly suggestive of the genus *Electrolabis* Alexander[5] of the Baltic Amber, a group that I am now inclined to consider identical with *Lipsothrix* Loew. In the latter case, vein R_{1+2} is elongate, whereas in the present fly it is short, curved abruptly into the margin, and thus in almost transverse alignment with vein R_2.

The known distribution of the genus, with one species in Formosa and another in southeastern China, is very interesting. Gressitt, in a significant paper on the zoögeographical relationships of Formosa,[6] indicates a type of distribution in the island where the species concerned must have found their way into Formosa through Siam and Indo-China, rather than by way of the Philippine Archipelago. The present instance would seem to fall within this category.

PEDICIINI

DICRANOTA (RHAPHIDOLABIS) CLAUSA sp. nov. Plate 1, fig. 13; Plate 3, fig. 38.

General coloration of head and thorax light gray, præscutum with three darker, brownish gray stripes; antennæ 17-segmented; femora yellow basally, tips broadly blackened, most extensively so on the fore pair; wings with a yellow tinge, more conspicuous in the prearcular and basal costal regions; stigma oval, dark brown; darkened seams on cord, outer end of cell 1st M_2, and along vein Cu; R_{2+3+4} a little shorter than basal section of R_5; cell 1st M_2 closed; cell M_1 subequal to its petiole; abdomen dark brown, basal sternites more obscure yellow; male hypopygium with the tergite extensive, gradually narrowed outwardly, apex with a shallow median notch.

Male.—Length, about 9 millimeters; wing, 9.8.

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[4] Philip. Journ. Sci. 35 (1928) 466, 467.

[5] Bernstein-Forschungen (2) (1931) 58.

[6] Entomological World. Tokyo 4 (1936) 711–727.

Rostrum black, pruinose; palpi black. Antennæ 17-segmented, black, scape and pedicel more pruinose; flagellar segments oval; verticils shorter than segments. Head light gray.

Pronotum light gray. Mesonotal præscutum light gray, with three darker brownish gray stripes, the broad median stripe divided by a pale vitta on about its cephalic half; posterior sclerites of mesonotum gray, scutal lobes variegated with darker gray. Pleura clear ashy gray, dorsopleural membrane more dusky. Halteres yellow, knobs very slightly darker. Legs with coxæ pale, fore coxæ more darkened; trochanters yellow; femora yellow basally, tips broadly blackened, most widely so on fore pair where about the distal two-thirds is darkened, narrowest on posterior femora where about the outer fourth is blackened; tibiæ and tarsi brownish black to black. Wings (Plate 1, fig. 13) with ground color yellowish, prearcular field and basal costal region clear light yellow; stigma oval, dark brown; rather conspicuous dark seams on cord, outer end of cell 1st M_2, and along vein Cu; extreme wing tip a little darkened; veins brown, brightened in the flavous areas. Venation: Sc_1 ending nearly opposite the level of m; Rs relatively long, only feebly arcuated; R_{2+3+4} somewhat shorter than basal section of R_5; cell 1st M_2 closed; cell M_1 subequal to its petiole.

Abdomen, including hypopygium, dark brown; basal sternites more obscure yellow. Male hypopygium (Plate 3, fig. 38) with tergite, *9t*, extensive, gradually narrowed outwardly, apex with a shallow median notch; lateral lobes very low, obliquely truncated; lateral tergal arms produced into elongate yellow blades. Basistyles, *b*, relatively short and stout; interbase, *i*, a curved flattened blade, bearing a small, toothlike spine at the lower mesal angle. Outer dististyle, *od*, with relatively few spines. Inner dististyle, *id*, with a very extensive shoulder on basal half.

Habitat.—Japan (Honshiu).

Holotype, male, Matsuo, Iwate, altitude 3,250 feet, June 7, 1936 (*Yamamoto*).

Dicranota (*Rhaphidolabis*) *clausa* is so distinct from all other described species that it requires no comparison with any. The closed cell 1st M_2 is unique in the subgenus, while the excessive number of antennal segments is equalled only in the otherwise very distinct *D.* (*R.*) *polymera* Alexander. In its general appearance the present fly somewhat resembles *D.* (*R.*) *flavibasis* (Alexander), but is an entirely different fly. The presence of a close cell 1st M_2 gives the fly somewhat the appearance of a member of the subgenus *Amalopina* Brunetti, but the reference to *Rhaphidolabis* seems undoubtedly to be the correct one.

HEXATOMINI

LIMNOPHILA (PRIONOLABIS) NIGROFEMORATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 39.

Large (wing, male, over 10 millimeters); antennæ black throughout; thorax black, surface very sparsely pruinose; halteres elongate, knobs infuscated; legs black; wings broad, whitish, with a sparse pale-brown pattern; male hypopygium with caudal margin of tergite emarginate medially; outer dististyle with abundant microscopic spinulæ on outer margin; inner dististyle with a conspicuous arm on outer margin before apex, tip set with numerous blackened spinous points.

Male.—Length, 9 to 10 millimeters; wing, 10.5 to 11.5.

Rostrum and palpi black. Antennæ black throughout, 15-segmented, in the paratype with the basal two flagellar segments partly fused; flagellar segments oval, with verticils that slightly exceed the segments in length. Head black, surface sparsely pruinose.

Thorax black, præscutum a little dulled by a sparse pruinosity. Pleura dusted with gray. Halteres elongate, stem pale, knob strongly infuscated. Legs black throughout. Wings (Plate 1, fig. 14) broad; ground color whitish, prearcular and costal portions restrictedly pale yellow; stigma oval, brown; restricted pale brown seams along cord, outer end of cell 1st M_2, and vein Cu; veins pale brown, brighter in the flavous areas. Venation: R_{2+3+4} not in longitudinal alignment with Rs, being a little elevated; R_{1+2} and R_2 subequal; cell M_1 exceeding its petiole; m-cu beyond midlength of cell 1st M_2.

Abdomen, including hypopygium, black, surface scarcely pruinose. Male hypopygium (Plate 3, fig. 39) with caudal margin of tergite, *9t*, conspicuously emarginate medially. Outer dististyle, *od*, slender without a conspicuous flange on outer margin; in the type with a single well-developed tooth on mesal edge, in the paratype with two or three poorly-indicated denticles; outer margin of style with abundant microscopic appressed spinulæ. Inner dististyle, *id*, with a conspicuous arm on outer margin before apex, this set with numerous microscopic blackened spinous points. Gonapophyses, *g*, narrow, yellow. Ædeagus, *a*, greatly compressed but relatively broad in relation to the length.

Habitat.—Japan (Honshiu).

Holotype, male, Mount Nanshō, Iwate, altitude 2,600 feet, November 4, 1934 (*Kato*); collector's No. 5. Paralopotype, male.

Limnophila (*Prionolabis*) *nigrofemorata* is readily told by the large size, the black legs, and the structure of the male hypopygium, especially of the styli. In the Japanese fauna the species is exceeded in size only by *L.* (*P.*) *rufipennis* Alexander, which has the male hypopygium of quite distinct construction.

LIMNOPHILA (PRIONOLABIS) YAMAMOTANA sp. nov. Plate 1, fig. 15; Plate 3, fig. 40.

Small (wing, male, 7.5 millimeters); general coloration polished black; number of antennal segments variable; halteres yellow; fore femora with outer two-thirds blackened, middle and hind femora with tips narrowly darkened; wings weakly tinged with brownish, prearcular and costal regions light yellow; a restricted pale-brown pattern; male hypopygium with median area of tergite produced, its margin weakly trilobed; inner dististyle with a comb of four long teeth on outer margin before apex; gonapophyses narrow, dusky.

Male.—Length, about 6 millimeters; wing, 7.5.

Female.—Length, about 7.5 to 8 millimeters; wing, 7.

Rostrum and palpi black. Antennæ black throughout; antennal segments variable in number, in the holotype male 14-segmented, with basal two flagellar segments partly fused, terminal segment elongate and apparently the result of fusion. In the allotype female there appear to be only nine segments; paratype female with fifteen segments. Head black, sparsely pruinose.

Thorax black, dorsum somewhat polished, pleura slightly more pruinose but inconspicuously so. Halteres yellow. Legs with coxæ and trochanters black; fore femora yellow basally, with about the distal two-thirds blackened; remaining femora yellow, tips narrowly blackened, the amount including about the outer fifth or sixth; tibiæ obscure yellow, tips slightly darkened; tarsi passing through yellowish brown to black. Wings (Plate 1, fig. 15) moderately broad, with a weak brownish tinge, prearcular and costal fields light yellow; stigma dark brown; a restricted pale-brown pattern, including clouds at origin of Rs, cord, outer end of cell 1st M_2, and a seam along vein Cu; veins brown, brightened in the flavous areas. Venation: Cell M_1 subequal to or shorter than its petiole; m-cu close to midlength of cell 1st M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 40) with median area of caudal margin of tergite, *9t*, a little produced, edge very insensibly trilobed to nearly truncate. Outer dististyle, *od*, with a single lateral spine; inner dististyle, *id*, with a comb of three long and a shorter outer spine before the abbreviated black tip. Gonapophyses, *g*, dusky, relatively narrow, outer third or fourth gradually narrowed, tip obtuse. Ovipositor with the cerci very long and slender, almost straight.

Habitat.—Japan (Honshiu).

Holotype, male, Matsuo, Iwate, altitude 1,625 feet, June 6, 1936 (*Yamamoto*). Allotopotype, female, with the type. Paratopotype, female, with the type.

This interesting *Prionolabis* is named in honor of the collector, Mr. Hiromu Yamamoto, to whom I express my thanks for valuable coöperation in studying the Japanese Tipulidæ. The nearest ally is *Limnophila* (*Prionolabis*) *odai* Alexander, which is likewise a species of small size, with the ninth tergite of the male hypopygium somewhat similarly produced and weakly trilobed. The present fly differs in the broadly darkened fore femora, brown-tinged wings, and the details of the male hypopygium, notably the inner dististyle and the narrow dusky gonapophyses. The variability in number of antennal segments in the present species is very surprising, and more material will be needed to show the true range in number of segments. It scarcely seems possible that the three specimens constituting the type series all represent teratological individuals.

HEXATOMA (ERIOCERA) INSIDIOSA sp. nov. Plate 1, fig. 16.

Belongs to the *verticalis* group; general coloration black, præscutum without stripes; antennæ (female) 8-segmented, scape and pedicel obscure brownish yellow, flagellum black; vertical tubercle simple; halteres black; fore femora chiefly black, remaining femora obscure brownish yellow, tips narrowly blackened; wings with a strong brown suffusion; stigma subcircular, darker brown; outer radial and medial veins with abundant trichia; R_{1+2} and R_2 subequal, the latter at fork of R_{2+3+4}; m-cu about one-third its length beyond fork of M; abdominal segments bicolorous, brown or brownish yellow, caudal margins black.

Female.—Length, about 12 millimeters; wing, 11.

Rostrum dark brown; palpi black. Antennæ (female) 8-segmented; scape and pedicel obscure brownish yellow, flagellum black; flagellar segments cylindrical, gradually decreasing in length outwardly; two outermost segments subequal. Head with vertical tubercle bulbous, simple, dark brown; remainder of head more heavily pruinose.

Pronotum dark brown. Mesonotal præscutum uniformly black, subnitidous, without stripes; præscutal setæ very small and sparse; posterior sclerites of notum blackened, with a relatively sparse yellow or grayish yellow bloom. Pleura black, sparsely dusted with gray. Halteres black. Legs with coxæ black, sparsely dusted with gray; trochanters brownish yellow; fore femora black, bases narrowly obscure yellow; remaining femora obscure brownish yellow, tips narrowly blackened; tibiæ brownish black to black, tips blackened; tarsi black. Wings (Plate 1, fig. 16) with a strong brown suffusion; stigma subcircular, darker brown; longitudinal veins very indistinctly and vaguely seamed with dusky; veins dark. Costa with long coarse trichia; veins R_{2+3+4}, R_3, R_4, R_5, and outer sections of M_{1+2} and M_3 with conspicuous trichia. Venation: R_{1+2} and R_2 subequal, latter at fork of R_{2+3+4}; Rs relatively long, fully twice R_{2+3+4}; m-cu about one-third its length beyond fork of M, subequal to distal section of Cu_1.

Abdominal segments bicolorous, sternites more distinctly so than tergites, both pale brown or brownish yellow, with the caudal half to third of individual segments blackened; genital shield dark brown; valves of ovipositor elongate, brownish yellow; hypovalvæ blackened at bases.

Habitat.—China (Kwangtung).

Holotype, female, Loh Fau Shan, near the Wa Shan Tói Monastery, in woods, altitude about 800 feet, April 27, 1936 (*Tinkham*).

The nearest ally of the present fly is *Hexatoma* (*Eriocera*) *nipponensis* (Alexander), of Japan, which has similar trichia on the outer wing veins but differs conspicuously in the coloration of the body. *H.* (*E.*) *nigrina* (Riedel) and *H.* (*E.*) *verticalis* (Wiedemann) have the veins beyond cord, with the exception of the outer section of R_5, without trichia.

HEXATOMA (ERIOCERA) MIRANDA sp. nov. Plate 1, fig. 17.

Belongs to the *dichroa* group; general coloration black; antennæ (male) 7-segmented, terminal segment more than one-half length of penultimate; mesonotal præscutum with four reddish brown stripes that are narrowly bordered by velvety black; halteres and legs black; wings long and narrow, dark brown, with a narrow yellow crossband before cord; bases of anal cells conspicuously light yellow; R_{1+2} very long, considerably exceeding the long R_{2+3+4}; cell M_1 longer than its petiole; abdomen velvety black, tergites two to five deep orange, except the base of tergite two and the apex of tergite five.

Male.—Length, about 17 millimeters; wing, 19.5; antenna, about 3.5.

Rostrum and palpi black. Antennæ (male) 7-segmented, black throughout; flagellar segments very gradually decreasing in length outwardly, segment five more than one-half length of penultimate. Head black, sparsely gray pruinose, with coarse black setæ; a slender median vertical tubercle, with paired smaller tubercles on either side behind antennal bases.

Pronotum black, pruinose. Mesonotal præscutum with ground color grayish, with four reddish brown stripes that are narrowly bordered by velvety black; setæ of interspaces long and erect; posterior sclerites of mesonotum brownish black. Pleura brownish black, dorsopleural membrane even darker. Halteres black. Legs black throughout. Wings (Plate I, fig. 17) long and narrow, about four and one-half times as long as wide; ground color dark brown, including prearcular and costal regions; a narrow but conspicuous yellow crossband before cord, extending from vein R_1 to posterior margin, a little suffused and interrupted along vein M; bases of both anal cells conspicuously pale yellow, including about proximal third of cell 2d A; veins yellowish brown to brown, clearer luteous in yellow areas. Costa with abundant trichia; R_{2+3+4} and R_{3+4} together with outer medial veins, almost without trichia, a few scattered trichia near outer end. Venation: Rs a little shorter than R, about twice R_{2+3+4}; R_{1+2} unusually long, considerably exceeding R_{2+3+4}; cell M_1 longer than its petiole; m-cu shortly beyond midlength of cell 1st M_2.

Abdomen uniform velvety black, with the exception of tergites two to five which are deep orange, base and sides of tergite two and apex of tergite five velvety black; hypopygium black; abdominal tergites without differentiated basal rings.

Habitat.—Western Java.

Holotype, male, Goenoeng Besser, Mount Djampangs, May, 1936 (*Walsh*).

Hexatoma (*Eriocera*) *miranda* is very distinct from all other members of the *dichroa* group in the conspicuously banded wings. In the latter feature the fly somewhat resembles *H.* (*E.*) *meso-*

pyrrha (Wiedemann), but belongs to an entirely different group of species, being more nearly allied to *H.* (*E.*) *ferruginosa* (van der Wulp).

HEXATOMA (ERIOCERA) CELESTIA sp. nov. Plate 1, fig. 18.

Belongs to the *nepalensis* group; general coloration opaque black; antennæ (male) 8-segmented, black throughout; femora yellow, tips narrowly black, the amount subequal on all legs; wings dark brown, with a conspicuous whitish hyaline crossband extending from costa obliquely backward almost to vein Cu, widest in cells R and M; anal cells and central portion of cell Cu abruptly paler than ground; R_2 transverse; cell M_1 lacking; basal portions of intermediate tergites more nacreous and shiny.

Male.—Length, about 20 millimeters; wing, 16; antennæ, 5.

Rostrum black; palpi relatively long, black throughout. Antennæ (male) 8-segmented, black throughout; flagellar segments gradually decreasing in length and diameter, last two subequal. Head black; vertical tubercle inconspicuous; setæ on occipital region long and conspicuous.

Thorax entirely black, without stripes; præscutal setæ erect, small, inconspicuous. Halteres black. Legs with coxæ and trochanters black; femora yellow, tips narrowly (2 millimeters) black, the amount subequal on all legs; tibiæ obscure yellow, tips narrowly blackened; basitarsi brown, tips blackened; remaining tarsal segments black. Wings (Plate 1, fig. 18) dark brown, including prearcular field; cell C, basal half of Sc, and basal portion of R_1 more yellowish brown; an oblique, whitish-hyaline crossband before cord, beginning at costa at end of Sc, very narrow in cells Sc_1 and R_1, much wider and forming an oval area in outer ends of cells R and M, not quite attaining vein Cu posteriorly; small pale areas before origin of Rs in cell R and in cell R_4 adjoining vein R_4; anal cells abruptly grayish, confluent with a whitish hyaline area at midlength of cell Cu; veins dark brown, brighter in the yellow costal portions. Numerous macrotrichia on veins R_3, R_4, and distal section of R_5; more sparse trichia on distal ends of outer branches of M. Venation: Rs long, nearly twice R; R_{1+2} about twice R_{2+3}; R_2 transverse; R_{2+3+4} shorter than R_{1+2}; cell M_1 lacking; m-cu beyond two-thirds length of cell 1st M_2.

Abdomen black, basal portions of intermediate tergites broadly more nacreous and shiny; sternites, subterminal tergites, and hypopygium more uniformly opaque black.

Habitat.—China (Kwangtung).

Holotype, male, Gow Bo Shan, Sui Hit Chi, Yue Hing Ying, Sixth District, on mountain grass, July 4, 1936 (*Tsz Hai*).

Hexatoma (*Eriocera*) *celestia* is very different from other regional members of the subgenus, the abrupt paling of the anal cells and the nearly hyaline central portion of cell Cu contrasting conspicuously with the dark ground color of the wing. By Edwards's key to the Old World species of *Eriocera*,[7] the species runs to *hilpa* (Walker), a very distinct fly.

HEXATOMA (ERIOCERA) AMBROSIA sp. nov. Plate 1, fig. 19.

Belongs to the *nepalensis* group; general coloration black, præscutum with three polished black stripes; antennæ (female) 11-segmented; femora yellow, tips narrowly blackened, the amount subequal on all legs; wings dark brown, costal portion conspicuously yellow; a narrow, whitish hyaline crossband before cord; numerous trichia on veins beyond cord; cell M_1 lacking; bases of abdominal tergites polished; genital segment fiery orange.

Female.—Length, about 17 millimeters; wing, 12; antenna, 3.5.

Rostrum and palpi black. Antennæ (female) 11-segmented, black throughout; flagellar segments one to six gradually decreasing in length and thickness; terminal three segments short, subequal in length. Head dull black, very sparsely pruinose; vertical tubercle low and simple; vertex with abundant long coarse setæ.

Pronotum dull black. Mesonotal præscutum with restricted interspaces dull black, disc chiefly covered by three polished black stripes; setæ restricted to posterior half of præscutal interspaces, long, conspicuous, erect; posterior sclerites of mesonotum chiefly polished black. Pleura and pleurotergite dull black. Halteres black throughout. Legs with coxæ and trochanters black; femora bright yellow, tips narrowly (less than 1 millimeter) and abruptly blackened, the amount subequal on all legs and involving distal eighth to tenth of segment; tibiæ and basitarsi yellowish brown, tips narrowly brownish black; remainder of tarsi black. Wings (Plate 1, fig. 19) with ground color dark brown; anal cells more grayish, but vicinity of vein 2d A somewhat clouded; costal border conspicuously yellow, involving cell Sc and much of cell R_1 beyond origin of Rs, the latter portion of the area crossing Rs into margin of cell R; cell C more brownish yellow, clearer yellow at ends; a narrow whitish hyaline crossband before cord, extending from vein R_1 into cell Cu, nearly parallel-sided except at either end, distal edge touching fork of Rs; veins dark brown, more yellowish in brightened areas. Costa with very abundant trichia; veins beyond cord with numerous trichia, involving both radial and medial fields; Cu virtually without trichia; distal ends of Rs and M with sparse long trichia. Venation: h nearly transverse; Sc_2 some distance before tip of Sc_1, lying before fork of Rs; R_2 and R_{2-3} subequal, the former a little oblique; cell M_1 lacking; m-cu beyond midlength of lower face of cell 1st M_2, in one wing of type more distad than in the other.

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[7] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

Abdomen opaque black, tergites two to seven, inclusive, with polished, more plumbeous, basal rings; sternites more uniformly opaque black, polished bases narrow and ill-defined; genital shield fiery orange; cerci elongate, yellowish horn-colored.

Habitat.—China (Kwangtung).

Holotype, female, Gow Bo Shan, Sui Hit Chi, Yue Hing Ying, Sixth District, July 2, 1936 (*Tsz Hai*).

By Edwards's key to the Old World species of *Eriocera* [*] the present fly runs to *Hexatoma* (*Eriocera*) *kilpa* (Walker), an entirely distinct fly. The nearest regional species would appear to be *H.* (*E.*) *celestia* sp. nov., which differs especially in the opaque præscutal stripes and in the pattern of the legs and wings.

HEXATOMA (ERIOCERA) CANTONENSIS sp. nov. Plate 1, fig. 20.

General coloration black, præscutum with four more polished black stripes; head and mesonotum with coarse black setæ; antennæ, halteres, and legs black; wings blackish, with a conspicuous, more yellow brightening before cord, apical cells darkened; cell M_1 present but variable in length; hypopygium black; genital shield of ovipositor orange.

Male.—Length, 10 to 16 millimeters; wing, 10.5 to 16; antenna, 3.5 to 4.

Female.—Length, 20 to 22 millimeters; wing, 15 to 17; antenna, 4.

Rostrum and palpi black. Antennæ of male 8-segmented, of female 9-segmented, black throughout; flagellar segments cylindrical, gradually decreasing in length outwardly, last two subequal. Head black, with coarse black setæ; vertical tubercle relatively low and inconspicuous.

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[*] loc. cit.

Thorax opaque black; præscutum with four more polished black stripes, the intermediate pair separated only by a narrow velvety black line; posterior portion of præscutum with long black setæ, chiefly on interspaces but including the posterior ends of the intermediate stripes; centers of scutal lobes somewhat polished. Pleura black. Halteres and legs black throughout. Wings (Plate 1, fig. 20) with a blackish tinge, more grayish in the cubital and anal cells; a more yellowish, ill-delimited brightening before cord, including parts of cells R_1, R, and M, merging very insensibly with the ground; veins black. Abundant macrotrichia on veins beyond cord, fewer and more scattered on M_3 and M_4; costal setæ dense in both sexes. Venation: R_{2+3+4} shorter than R_{2+3}; R_{1+2} relatively long, from one and one-half to two times R_{2+3+4}; inner end of cell 1st M_2 arcuated to angulated; cell M_1 small, variable in length, in abnormal cases and including one wing of the holotype, lost by fusion of veins M_1 and M_2 to margin; m-cu at or before midlength of cell 1st M_2.

Abdomen, including hypopygium, black, without differentiated tergal rings. Female with genital shield orange; ovipositor ferruginous; cerci long and slender.

One female (Sui Hit Chi, Gow Bo Shan, northern Kwangtung, May 15, 1936) has the wings, with the exception of the costal border and cells beyond cord, chiefly obscure yellow, and R_2 somewhat more oblique. I consider this individual a variant of the present fly.

Habitat.—China (Kwangtung, Kiangsi).

Holotype, male, north side of Paak Wan Shan (White Cloud Mountain), Canton, near stream, altitude 200 to 500 feet, April 28, 1936 (*Tsz Hai*). Allotopotype, female. Paratopotypes, several males and females, April 28 to May 4, 1936 (*Tsz*). Paratype, 1 male, Kuling, Kiangsi, altitude 3,250 feet, August 27, 1935 (*Monteil*); in the Musée Heude, Shanghai.

The present fly is most closely allied to *Hexatoma* (*Eriocera*) *morula* (Alexander), of Szechwan, western China, which has the outer medial cells of the wings pale and the venational details distinct. In the latter fly Cu_2 is very short, about one-half m-cu, and bent strongly caudad, widening cell M_4, while the inner end of cell 1st M_2 is not arcuated. The possibility is not excluded that the present fly is only racially distinct from *morula*.

ELEPHANTOMYIA (ELEPHANTOMYODES) EGREGIA de Meijere.

Elephantomyia egregia DE MEIJERE, Tijd. voor Ent. 56 (1913) 347, 348.

The type, a male, was from Nongkodjadjar, in the Tengger Mountains, eastern Java, collected in January by Jacobson. The still undescribed female is discussed below.

Female.—Length, excluding rostrum, about 9 millimeters; wing, 6.5; rostrum, about 4.

Characters as in the male, as described and figured by de Meijere, with the following differences: Flagellar segments long-oval, all but basal ones with very long verticils. Pronotum and dorsopleural region dark brown, mesepisternum weakly infumed, remainder of pleura, together with pleurotergite and lateral borders of mediotergite, light yellow. Legs black, femoral bases restrictedly brightened; basitarsi black, outer ends abruptly snowy white; succeeding tarsal segments snowy white, last segment infuscated. Wings with the pattern described by de Meijere, but the pale areas in cell R not oval but rectangular to quadrate in outline, like remaining pale areas on disc; pale area in cell R_1 only about one-half as long as the one immediately beneath it in the outer end of cell R. Venation: m-cu at midlength of cell 1st M_2; cell 2d A long and narrow, parallel-sided for virtually its whole length, not narrowed and obliterated at proximal end as figured by de Meijere.

Allotype, female, Mount Ardjano, eastern Java, altitude 6,000 to 7,000 feet, January, 1936 (*Walsh*).

ELEPHANTOMYIA (ELEPHANTOMYODES) MACKERRASI Alexander.

Elephantomyia (Elephantomyodes) mackerrasi ALEXANDER, Philip. Journ. Sci. 53 (1934) 287, 288.

The types were from Mount Malabar, Java, altitude 4,000 feet, collected in May by Mackerras. One male, Soember Brantas, Mount Ardjano, eastern Java, altitude 6,000 feet, January 14 to 25, 1936 (*Walsh*). The coloration of the mesonotum is a little darker than in the type.

ERIOPTERINI

Genus GONOMYIA Meigen

Gonomyia MEIGEN, Syst. Beschr. 1 (1818) 146.

Characters as in the subgenus *Idiöcera* Dale (*Ptilostena* Bergroth), differing in the presence of a supernumerary crossvein in cell R_4 of the wing beyond midlength (Plate 1, fig. 21).

Type of subgenus.—*Gonomyia (Euptilostena) reticulata* Alexander (Eastern Palæarctic Region).

Other members of the group include *G.* (*E.*) *jucunda* Loew (Western Palæarctic) and *G.* (*E.*) *supernumeraria* sp. nov. (Oriental).

In case *Idiocera* Dale is recognized as a genus distinct from *Gonomyia* Meigen, the present group will deserve subgeneric ranking in it. Edwards has recently made the discovery that the name *Idiocera* Dale, overlooked by Kertész and other cataloguers of the Tipulidæ, is the correct name for what has long been called *Ptilostena.* Of the various groups that have been proposed in the older group *Gonomyia*, *Lipophleps* Bergroth and *Gonomyia* Meigen lack the anterior arculus of the wings, while the remaining groups, *Protogonomyia* Alexander, *Progonomyia* Alexander, *Ellipterodes* Becker, *Ptilostenodes* Alexander, *Idiocera* Dale, and *Euptilostena* subgen. nov., have this present.

GONOMYIA (EUPTILOSTENA) SUPERNUMERARIA sp. nov. Plate 1, fig. 21.

General coloration of mesonotum gray, præscutum faintly lined with brown; antennæ black, pedicel paler; pleura yellow, darkened dorsally; halteres brownish black; legs yellow; wings whitish, faintly suffused with brown; a heavy brown pattern restricted to the vicinity of the veins; abdominal tergites dark brown, caudal margins narrowly ringed with pale; hypovalvæ of ovipositor black.

Female.—Length, about 7 millimeters; wing, 6.

Rostrum black; palpi brownish black. Antennæ with scape brownish black; pedicel obscure brownish yellow; flagellum black; flagellar segments long-oval, verticils exceeding segments. Front and anterior vertex obscure yellow; posterior vertex gray pruinose; anterior vertex with a more darkened median area.

Mesonotum dark, light gray pruinose, præscutum with indications of darker stripes; scutellum more brownish yellow. Pleura obscure yellow, dorsal pleurites and pleurotergite more blackened. Halteres brownish black. Legs with fore coxæ darkened, remaining coxæ and all trochanters yellow; remainder of legs yellow, outer tarsal segments darkened. Wings (Plate 1, fig. 21) whitish, with a weak brown suffusion, prearcular and costal portions more luteous; a restricted dark-brown pattern arranged as follows: Origin of Rs, stigma, anterior cord, supernumerary crossvein in cell R_4, distal section of vein R_4, and m-cu; veins pale brown, darker in the clouded areas, more yellowish in the luteous portions. Venation: Sc_1 ending just beyond origin of Rs, Sc_2 far from its tip, at near three-fifths the distance between arculus and origin of Rs; R_{1+2} and R_3 only narrowly separated along costal margin; distal section of vein R_4 and supernumerary crossvein subequal in length, in nearly transverse alignment; m-cu about one and one-half times its length before fork of M.

Abdominal tergites dark brown, caudal margins narrowly ringed with pale, broader and more yellow on basal two or three segments, becoming narrower and more obscure on outer tergites; sternites paler, obscure yellow, especially on outer segments; pleural membrane yellow. Genital shield and cerci pale; hypovalvæ powerfully constructed, black.

Habitat.—Western Java.

Holotype, female, Goenoeng Besser, Djampangs, April, 1936 (*Walsh*).

Gonomyia (*Euptilostena*) *supernumeraria* is readily told from all regional species of the genus by the subgeneric character of a supernumerary crossvein in the wings. In the general nature of the wing pattern the fly most resembles species such as *Gonomyia* (*Idiocera*) *punctipennis* Edwards.

GONOMYIA (LIPOPHLEPS) BIACULEATA sp. nov. Plate 1, fig. 22; Plate 3, fig. 41.

Belongs to the *incompleta* group; flagellar segments with a dense white pubescence; male hypopygium with the dististyle narrow, with two unusually long and slender blackened spines.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum testaceous brown; palpi darker. Antennæ with scape testaceous, remaining segments black; flagellar segments with a long white pubescence but without elongate verticils. Head dark gray.

Pronotum dark brown. Mesonotal præscutum above dark brown, somewhat deeper in front, humeral portion yellow; posterior sclerites of notum dark brown. Pleura testaceous-yellow, anterior sclerites a little darker. Halteres dusky, stem yellow at base. Legs with fore coxæ darkened, remaining coxæ and all trochanters yellow; remainder of legs dark brown to black. Wings (Plate 1, fig. 22) with a brown tinge; stigma oval, a trifle darker brown; veins brown. Venation: Sc_1 ending a short distance before origin of Rs, distance on costa about one-half Rs alone; cell 1st M_2 strongly narrowed at proximal end.

Abdomen brown; hypopygium obscure yellow. Male hypopygium (Plate 3, fig. 41) with apical lobe of basistyle, *b*, stout, shorter than remainder of style. Dististyle, *d*, with the body very narrow, bearing two slender blackened spines, the outer stouter and nearly twice as long as the inner. Phallosome, *p*, as in *incompleta* and allies.

Habitat.—Central Java.

Holotype, male, Nglirip, djati forests, altitude 300 feet, January 1 to 7, 1936 (*Walsh*).

Gonomyia (Lipophleps) biaculeata is most nearly related to *G. (L.) bimucronata* Alexander (Luzon). Both species have the dististyles of the two sides symmetrical, in this respect differing from *incompleta* and allies where the dististyles are slightly asymmetrical and of very different conformation. In the present fly the body of the dististyle is very narrow, less than the length of either spine, whereas in *bimucronata* the spines are shorter and stouter, with the body of the structure much wider, nearly as wide as the total length of the outer spine alone.

GONOMYIA (LIPOPHLEPS) HORRIFICA sp. nov. Plate 1, fig. 23; Plate 3, fig. 41.

Belongs to the *alboannulata* group; mesonotum dark brown, scutellum yellow on posterior margin; femora with a broad black, nearly terminal ring; wings pale gray, unmarked; Sc_1 ending a short distance before origin of Rs; basal section of R_5 long; male hypopygium with three dististyles, the middle shorter than the outer, at apex with about a dozen powerful spines; inner dististyle bispinous; phallosome with the outer lateral arms appearing as flattened pale horns.

Male.—Length, about 3 to 3.2 millimeters; wing, 3.2 to 3.5.

Female.—Length, about 4 millimeters; wing, 4.

Rostrum and palpi black. Antennæ black; verticils (male) elongate. Head above yellow, darkened medially.

Pronotum yellow, restrictedly darkened medially. Pretergites narrowly china white. Mesonotal præscutum and scutum dark brown; scutellum dark brown, margined posteriorly with yellow; mediotergite dark, heavily pruinose, lateral margin on cephalic half restrictedly brightened; pleurotergite chiefly yellow. Pleura black, sparsely pruinose; dorsopleural region a trifle paler; a very conspicuous, yellowish white, longitudinal stripe extending from fore coxæ to base of abdomen, passing above middle and posterior coxæ. Halteres obscure yellow, knob chiefly dark brown, its apex a little brightened. Legs with fore coxæ white, midcoxæ obscure yellow, basal half blackened, posterior coxæ obscure yellow, slightly darkened at base; trochanters yellow; femora brownish yellow to brown, with a broad black ring, preceded by a very narrow clearer ring; on fore and middle femora the black rings are terminal, on the posterior femora subterminal, the apex narrowly yellow; tibiæ obscure yellow, extreme base and slightly more extensive apex blackened; tarsi black, basitarsi on proximal end slightly paler. Wings (Plate 1. fig. 23) with a pale gray tinge, unmarked; veins pale, those at cord a little darker. Venation: Sc_1 ending a short distance before origin of Rs, Sc_2 close to its tip; Rs strongly arcuated; basal section of R_5 long, about two-thirds r-m; cell 1st M_2 closed; m-cu before fork of M; cell 2d A wide.

Abdominal tergites dark brown, sternites paler; hypopygium brownish yellow. Male hypopygium (Plate 3, fig. 42) with outer dististyle, *od*, a blackened, paddlelike blade. Middle dististyle, *md*, only about four-fifths the length of outer, basal half slender, apex more dilated, bearing about a dozen powerful spines, the outer ones larger. Inner dististyle, *id*, bispinous, outer or lateral spine longer. Phallosome, *p*, with outer lateral arms appearing as pale flattened horns, with pale membrane along their inner or mesal margin. In the Tjolo paratypes the middle dististyle is more slender, with the teeth somewhat more appressed; spines of the inner style closer together.

Habitat.—Java.

Holotype, male, Soekaboemi, western Java, altitude 1,800 feet, February, 1934 (*Walsh*). Allotype, female, Tjolo, Goenoeng Moeria, northern Java, altitude 2,100 feet, December 1 to 8, 1935 (*Walsh*). Paratopotypes, 3 males, with the allotype.

The nearest allied species is *Gonomyia* (*Lipophleps*) *acuspinosa* Alexander, of western Sumatra, which has the details of the hypopygium quite distinct, the middle dististyle being equal in length to the outer and with a row of abundant small spines occupying almost the entire length of the style.

STYRINGOMYIA BICORNUTA sp. nov. Plate 1, fig. 24; Plate 3, figs. 43 to 46.

General coloration black, dorsopleural membrane pale; halteres black; legs black, extreme bases of femora and tibiæ and posterior basitarsi paler; wings with proximal half whitish, distal portion somewhat more clouded; darker seams along vein Cu and on anterior cord; costal fringe (male) unusually long and conspicuous; abdomen black, pleural membrane yellow; male hypopygium with the tergite produced caudad into two slender divergent horns.

Male.—Length, about 8 millimeters; wing, 5.

Rostrum blackish; palpi black. Antennæ with scape and pedicel black; flagellum weakly bicolored, brownish black, incisures slightly pale. Head black; bristles inconspicuous.

Pronotum black, paler laterally, with a pair of major setæ. Mesonotum black, præscutum sublaterally slightly gray pruinose;

mesonotal bristles slender, relatively inconspicuous. Pleura brown, dorsopleural region obscure yellow. Halteres black throughout. Legs black, extreme femoral and tibial bases obscure yellow; posterior basitarsi dirty white on basal two-thirds, remainder darker. Wings (Plate 1, fig. 24) with proximal half whitish, distal portion somewhat more clouded; a seam along vein Cu and a cloud on anterior cord darker; veins brown, darker in the clouded areas. Costal fringe (male) unusually long and conspicuous, erect, setæ gradually decreasing in length outwardly, becoming of normal length near wing tip. Venation: Anterior branch of Rs suberect; cell 1st M_2 relatively wide (compared to *holomelania*), shorter than cell 2d M_2 beyond it, the latter in punctiform contact with cell 1st M_2 to narrowly sessile; m-cu oblique, about its own length beyond fork of M; vein 2d A arcuated on distal portion.

Abdomen black, only pleural membrane yellow. Male hypopygium with tergite (Plate 3, fig. 43, *t*) produced into two slender blackened horns. Sternite (Plate 3, fig. 44, *9s*) narrow, at apex bearing the usual two strong bristles, placed rather close together at tip of median lobe. Basistyle (Plate 3, fig. 45, *b*) with two flattened spinous bristles, the outer from the summit of the usual apical lobe; second bristle sessile, widely separated from the first, at mesal-apical portion of basistyle. Dististyle (Plate 3, fig. 46, *d*) complex, as illustrated; outer arm, *od*, without spinous armature.

Habitat.—Eastern Java.

Holotype, male, Soember Brantas, altitude 6,000 feet, January 25, 1935 (*Walsh*).

Styringomyia bicornuta somewhat resembles *S. melania* Edwards (Western Java) and *S. holomelania* Alexander (Assam) in the extensive black coloration of the body and legs, differing in the very distinct structure of the male hypopygium, notably of the tergite.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *md*, middle dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

PLATE 1

FIG. 1. *Plocimas magnificus* Enderlein; venation.
2. *Pselliophora kangeanensis* sp. nov.; venation.
3. *Pselliophora biaurantia* sp. nov.; venation.
4. *Pselliophora upsilon* sp. nov.; venation.
5. *Tipula* (*Tipulodina*) *amabilis* sp. nov.; venation.
6. *Tipula* (*Vestiplex*) *takahashiana* sp. nov.; venation.
7. *Tipula* (*Vestiplex*) *niitakensis* sp. nov.; venation.
8. *Nephrotoma pallidapex* sp. nov.; venation.
9. *Dolichopeza* (*Dolichopeza*) *katoi* sp. nov.; venation.
10. *Dolichopeza* (*Nesopeza*) *thisbe* sp. nov.; venation.
11. *Dicranoptycha stygipes* sp. nov.; venation.
12. *Protohelius tinkhami* sp. nov.; venation.
13. *Dicranota* (*Rhaphidolabis*) *clausa* sp. nov.; venation.
14. *Limnophila* (*Prionolabis*) *nigrofemorata* sp. nov.; venation.
15. *Limnophila* (*Prionolabis*) *yamamotana* sp. nov.; venation.
16. *Hexatoma* (*Eriocera*) *insidiosa* sp. nov.; venation.
17. *Hexatoma* (*Eriocera*) *miranda* sp. nov.; venation.
18. *Hexatoma* (*Eriocera*) *celestia* sp. nov.; venation.
19. *Hexatoma* (*Eriocera*) *ambrosia* sp. nov.; venation.
20. *Hexatoma* (*Eriocera*) *cantonensis* sp. nov.; venation.
21. *Gonomyia* (*Euptilostena*) *supernumeraria* sp. nov.; venation.
22. *Gonomyia* (*Lipophleps*) *biaculeata* sp. nov.; venation.
23. *Gonomyia* (*Lipophleps*) *horrifica* sp. nov.; venation.
24. *Styringomyia bicornuta* sp. nov.; venation.

PLATE 2

FIG. 25. *Plocimas magnificus* Enderlein; antenna, female.
26. *Tipula* (*Vestiplex*) *bicornigera* sp. nov.; male hypopygium, ninth tergite.
27. *Tipula* (*Vestiplex*) *bicornigera* sp. nov.; male hypopygium, styli.
28. *Tipula* (*Oreomyza*) *niitakensis* sp. nov.; male hypopygium, lateral aspect.
29. *Tipula* (*Oreomyza*) *niitakensis* sp. nov.; male hypopygium, ninth tergite.
30. *Tipula* (*Oreomyza*) *niitakensis* sp. nov.; male hypopygium, styli.
31. *Nephrotoma nigrocentralis* sp. nov.; male hypopygium, ninth tergite.
32. *Nephrotoma nigrocentralis* sp. nov.; male hypopygium, styli.
33. *Nephrotoma pallidapex* sp. nov.; male hypopygium, outer dististyle.

FIG. 34. *Nephrotoma pallidapex* sp. nov.; male hypopygium, inner dististyle.
35. *Dolichopeza* (*Dolichopeza*) *katoi* sp. nov.; male hypopygium.
36. *Dolichopeza* (*Nesopeza*) *thisbe* sp. nov.; male hypopygium, detai

PLATE 8

FIG. 37. *Protohelius tinkhami* sp. nov.; male hypopygium.
38. *Dicranota* (*Rhaphidolabis*) *clausa* sp. nov.; male hypopygium.
39. *Limnophila* (*Prionolabis*) *nigrofemorata* sp. nov.; male hypopygium.
40. *Limnophila* (*Prionolabis*) *yamamotana* sp. nov.; male hypopygium.
41. *Gonomyia* (*Lipophleps*) *biaculeata* sp. nov.; male hypopygium.
42. *Gonomyia* (*Lipophleps*) *horrifica* sp. nov.; male hypopygium.
43. *Styringomyia bicornuta* sp. nov.; male hypopygium, tergite.
44. *Styringomyia bicornuta* sp. nov.; male hypopygium, sternite.
45. *Styringomyia bicornuta* sp. nov.; male hypopygium, styli.
46. *Styringomyia bicornuta* sp. nov.; male hypopygium, dististyle.

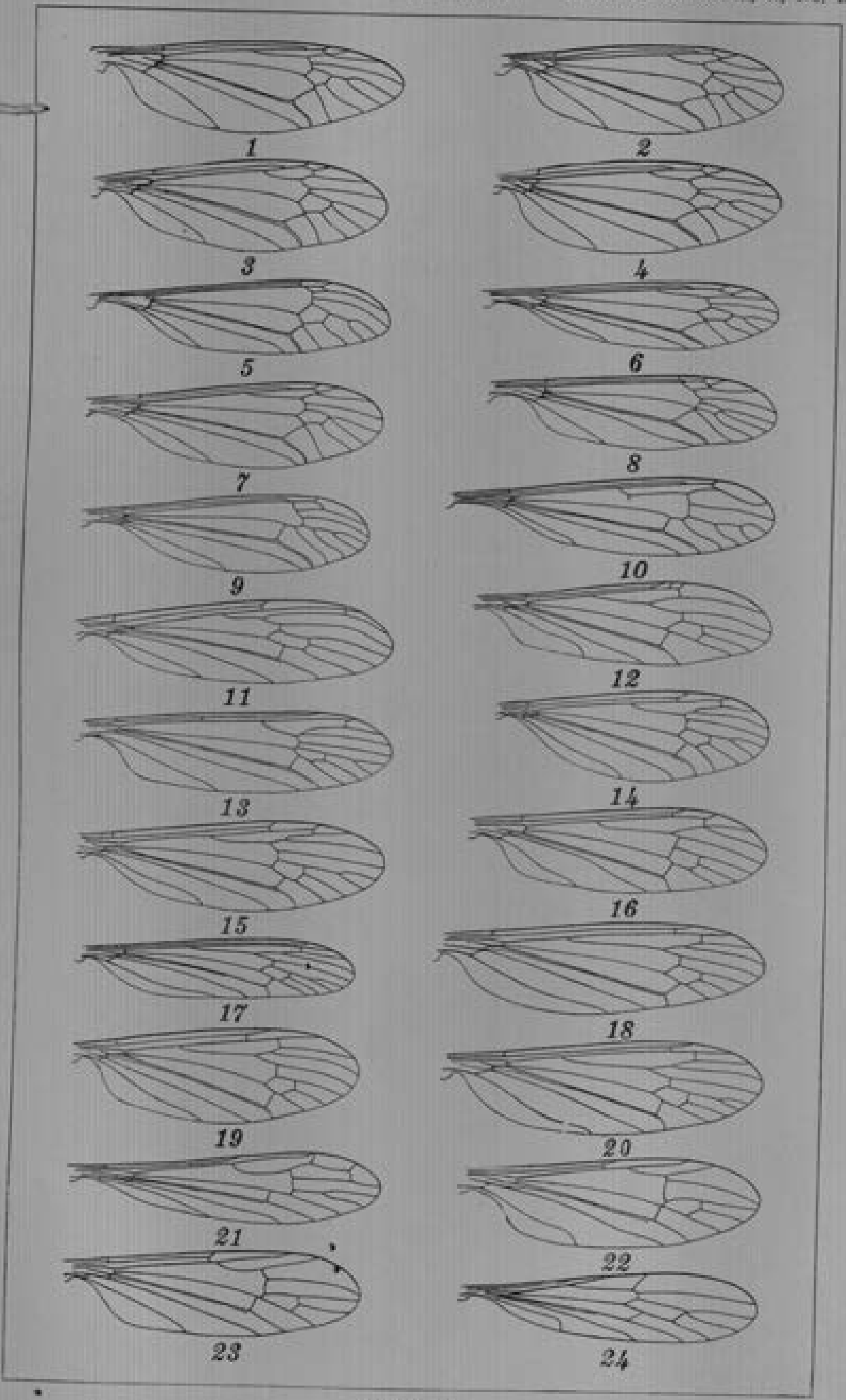
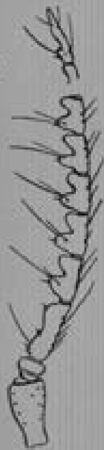


PLATE 1.



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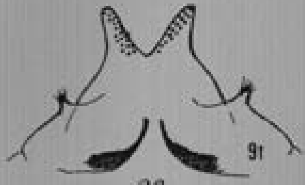

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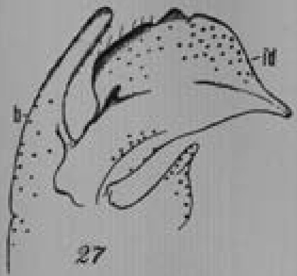

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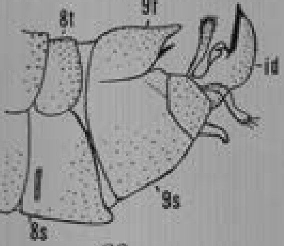

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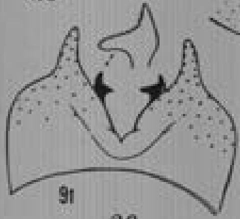

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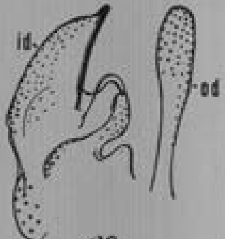

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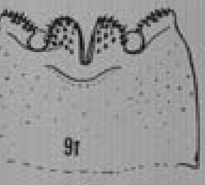

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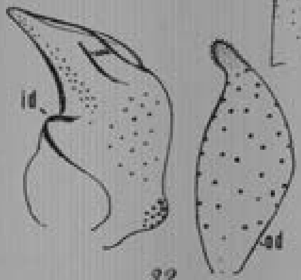

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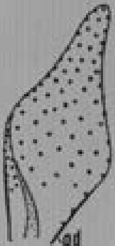

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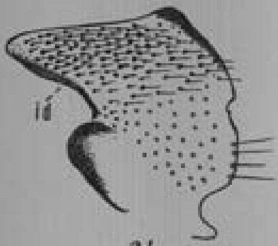

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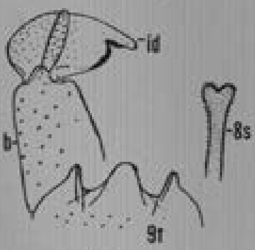

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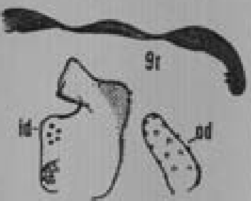

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PLATE 2.

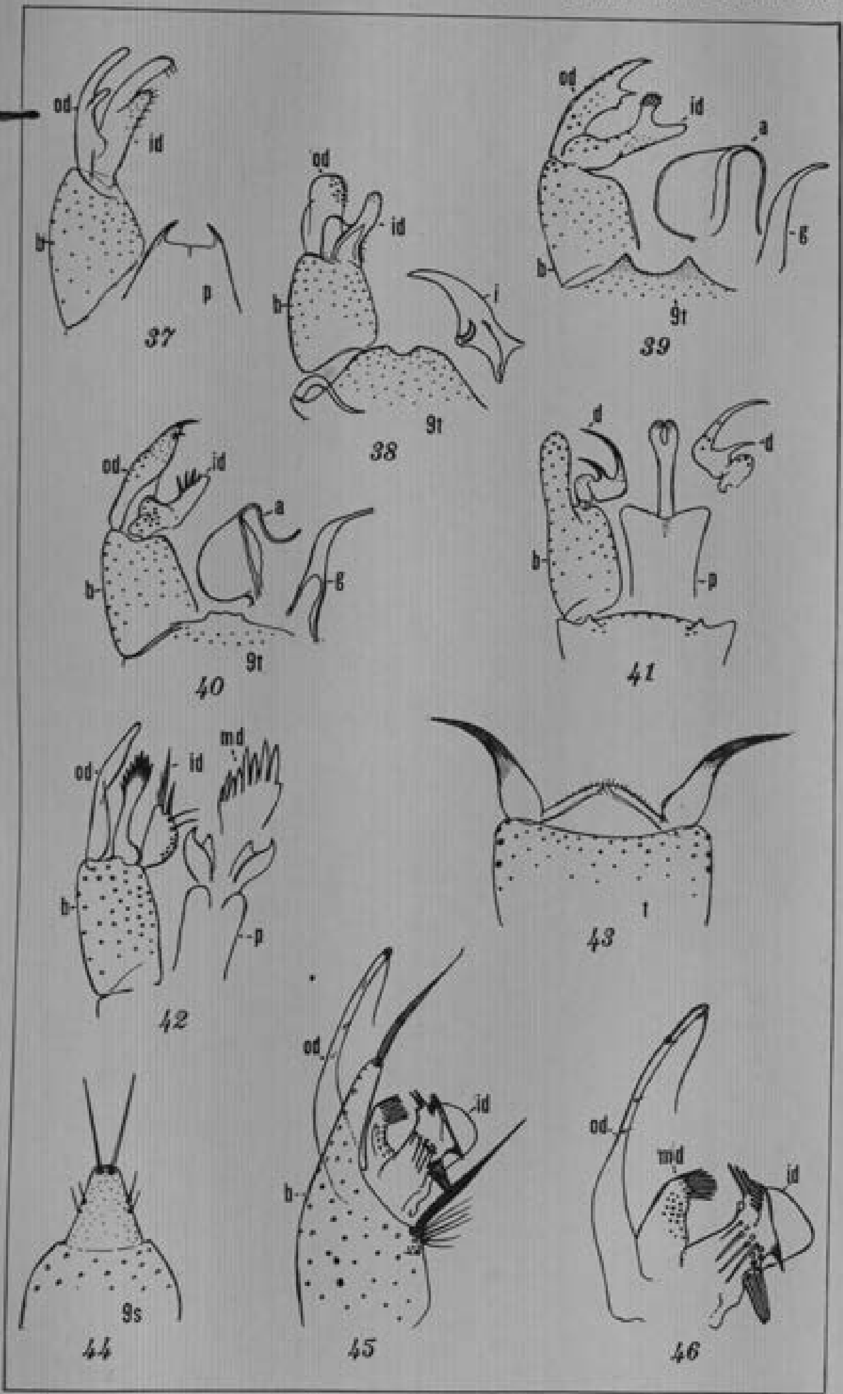
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PLATE 3.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

REVIEWS

Sickness and Insurance; A Study of the Sickness Problem and Health Insurance. By Harry Alvin Millis. Chicago, The University of Chicago Press. c1937. 166 pp., tables. Price, $2.

This little volume contains a clear and concise presentation of the social and economic problems created by sickness, and outlined suggestions for their solution. Mr. Millis discusses the sickness problem in the United States, and the various methods employed by the different underwriters, and shows the defects of the systems and the resulting tendency of group hospitalization and private-group medical clinics.

In his discussion of the cost of illness in the United States the author emphasizes that the problem of sickness in America is ranking next in importance to unemployment. His data, figures, and statistics show that families in the low-income group have the highest rate of disabling sickness, and are unable to meet the medical financial obligations of prolonged illness. Because of the insistent need for security against sickness, compulsory health insurance was adopted. Benefits provided by this system are: Cash benefit for lost income, medical services, and maternity and burial benefits in the majority of cases.

The author reviews the origin and development of compulsory health insurance in various European countries. The operation of the system depends upon the needs of each locality. He lays most emphasis on the system and experiences therewith in Germany, England, and France, citing their defects, which are difficult to correct. In England, compulsory health insurance has become a definitely established institution, rendering a new service to the masses.

In the latter part of the book the author makes a more extensive study of the present movement for and management of compulsory health insurance in America. He clearly presents both sides of the question, citing the reports of various committees who studied the problems of compulsory health insurance. The author's suggestions relative to the present sickness problem are: Prevention through public health institutions; cash benefits for wage earners when earnings are interrupted by sickness or by unemployment; and organized medical care of persons in the low-income group. The funds required should be contributed by the subscriber, the employer, and the government.—A. L. C.

A Century of Book Publishing, 1838–1938, Historical and Personal. By John Barnes Pratt. New York, A. S. Barnes and Company, 1938. 56 pp., portraits, illus.

A publishing house that has successfully existed a hundred years has certainly made a record and a name. We extend our warmest congratulations to A. S. Barnes and Company on its centennial in book publishing.

The book under review is a fascinating account of the growth and development of this publishing house under two persons—the founder, Alfred S. Barnes, and the present head, John Barnes Pratt, his nephew. During the pioneer period, "the young publisher had many difficulties to face and overcome, but his early training in what would be termed in these days a 'puritanical household' stood him in good stead, and his clear vision, his unbounded energy and above all his determination to publish only the best books, won for him and his company a high place in the esteem of the educators of that day, and prepared the way for larger usefulness in his chosen career."

Established in 1838, the original and main purpose of A. S. Barnes and Company was to publish a series of educational and textbooks that should excel in all essentials those then in use. The compilation and publication of a new series of high-grade hymnals for churches and schools was added later. In recent years there has also been added what is now recognized as probably the most attractive and authoritative line of books on health, physical education, recreation and sports, and allied subjects.—P. S. S.

Bombyliidæ of Palestine. By E. E. Austin. With seventy-two text figures, a frontispiece, a map by A. J. Engel Terzi, and three photographic plates. London, British Museum (Natural History), 1937. 188 pp., illus. Price, 15s.

This book is a notable contribution to the knowledge of the characteristic bombyliid fauna of Palestine, based on the bulk of the collections formed by the author and on other collections presented to the British Museum of Natural History by the Imperial Institute of Entomology.

This book is divided into two parts. Part one is an introductory by the author; part 2, which occupies a greater portion of the text, deals largely with the systematic account. The number of Bombyliidæ recorded in this volume is considered remarkable for the small size of Palestine, although the study of this family in Palestine is still far from complete. Species and varieties dealth with number 128, of which 46 are new. The genus *Lissomerus* is described as new. Notes on the nature, coloration, and economic importance of Palestine Bombyliidæ are also included, besides keys to the subfamilies, genera, and species of Bombyliidæ Homœophthalmæ and Bombyliidæ Tomophthalmæ.

The book is supplemented with a frontispiece, 72 text figures, 3 photographic plates, and a map, which are listed on three pages. This part of the book, together with the keys and descriptions, facilitates the identification of the Palestine Bombyliidæ.

An appendix is included, representing the 10 additional species of Bombyliidæ which probably occur in Palestine. The last six pages of the book are devoted to an index.—S. R. C.

Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vols. 1 to 4, 40 nos. London, British Museum (Natural History), 1930–34. Price, ₱100.

These monographs are comprehensive and varied. Ecology, biology, and physiology of invertebrates are well treated. In addition, invertebrate systematics, ichthyology, planktology, and hydrography studies are also included. These works will be very useful in connection with our researches in marine biology, oceanography, and similar studies.—H. A. R.

New Faces—New Futures; Rebuilding Character with Plastic Surgery. By Maxwell Maltz. New York, Richard R. Smith, 1936. 315 pp., illus. Price, $3.

According to the author, this book is the "story of plastic surgery from its crude beginnings twenty-five hundred years ago to its scientific precision of today that is presented in these pages. Effort has been made not only to describe its gradual growth but also to make clear the wide range of its present possibilities . . . True, the real plastic surgeon remodels features, reconstructs faces, but he does this in order that the afflicted may look forward to a future of tranquility and happiness."

Some of the important subjects taken up are the face, mouth, nose, wrinkles, skin, birthmarks and other blemishes, hair, breasts, and other disfigurements. The author has used to great advantage pictures "before and after" to supplement and make clear his discussions.

In writing his introduction of the book, Dr. Alfred Adler says, "I highly recommend this work to the medical profession and to the general reader who is interested in the welfare of his fellow men."—P. S. S.

Sculpture in the Living; Rebuilding the Face and Form by Plastic Surgery. By Jacques W. Maliniak. With a Foreword by Wendell C. Philips. New York., Romaine Pierson, Publishers, 1934. 203 pp., illus. Price, $3.

Plastic surgery is still a new branch of surgery. Dr. Maliniak deplores the misrepresentations given to this important branch of surgery, and bitterly condemns the attitude of the average layman that "the plastic surgeon is still a 'beauty doctor'; for the public has been educated—and usually miseducated—exclusively in the cosmetic aspects of this type of work." He also laments the fact that "some, even in the medical profession, do not understand its applicability to various situations." The task of the author, then, is to present "an authoritative book on surgical reconstruction, defining its nature and scope and explaining its limitations as well as its successes."

The author develops his subject first from the historical side, giving account of the rapid growth and development of plastic surgery during the World War. Then, chapter by chapter, he takes up skin, nose, lips, breast, eyes, ears, face, and disfigurements and other deformities. The book has covered chiefly the social and esthetic aspects of deformities, principally those of the face. The psychic and legal aspects of facial deformities are well covered, making the book very useful not only to physicians but also to medical students, jurists, and others who are interested in the scope and limitations of plastic surgery as well as what it can accomplish at the hands of experienced plastic surgeons.—P. S. S.

A summary of Legislation Relating to the Introduction of Plants into the Colonial Dependencies of the British Empire as at the End of December 1936. London, His Majesty's Stationery Office, 1937. 65 pp. Price, paper, $0.35.

This bulletin is an instructive and informative guide to those engaged in the introduction of seed and plant materials from foreign countries, as well as to those in the plant quarantine service of the British Government. The bulletin is a compilation of all legislative measures and ordinances adopted by the governments of the different British Colonies since 1876. It deals in detail with seed and plant materials that are completely denied entry into different dependencies of the British Empire, as well as with those materials that may enter therein under restricted conditions. These legislative measures are calculated to protect British Colonial crop industries from foreign pests and diseases. In this connection the bulletin likewise itemizes a long list of seed and plant materials that can be admitted to different dependencies of the British Empire under Government Plant Inspection Certificates and other specified requirements.—H. S. S.

Kama Sutra: The Hindu Science of Love. By Mallinaga Vatsyayana. Translated from the Sanskrit by Sir Richard Burton. "The Doctor as Marriage Advisor," by Max Hodan. Introduction by Hanns Heinz Ewers. New York, The Medical Press of New York, 1936. 127 pp. Price, $2.

This little book belongs to the class of contraband literature published with the transparent excuse of promoting harmony in marital relations. Highly discriminating medical men as marriage advisors will find the book interesting. This book will be most useful to advanced students of anthropology and ethnology.—P. S. S.

The Machinery of the Body. By Anton J. Carlson and Victor Johnson. Chicago, University of Chicago Press, c1937. 580 pp., illus. Price, $4.

Physiology has been considered a difficult subject, but with the aid of a textbook like the one under review the study of human physiology is made much more attractive, easy, and comprehensible. In this book the activities of the different departments and units of the human machine are clearly described and compared with those of other animals.

Following the practice in teaching elementary science in the university of Chicago where the authors are teaching, the illustrations used in this book have been taken from some of the films of the biology series. The authors are to be congratulated for being able to produce a most valuable textbook embodying their painstaking researches on the subject.—M. B.

Man in a Chemical World; the Service of the Chemical Industry. By A. Cressy Morrison. New York, Charles Scribner's Sons, 1937. 292 pp., illus. Price, $3.

In 1935 the American Chemical Society celebrated the tercentenary of the founding of chemical industries in America.

with the largest chemical meeting ever held. It pointed with pride to a record of achievement which few other American industries can match.

In order to commemorate this anniversary the Tercentenary Committee decided to have a book published to impress the man in the street with the fact that the chemical industries in the United States render a service that touches practically every activity in which he engages.

The expectations of the Committee were fully realized. For this book emphasizes the fact that chemical research has been very helpful in developing numerous familiar industrial products. Many topics, such as foods, water purification, anæsthetics, fertilizers, airplanes, rayon underwear, plastics, paper, leather, lacquer paints, new alloys, synthetic rubber, and others, are discussed from a popular chemical point of view.

Especially interesting is L'Envoi, in which the author traces the manufacture of the book as follows:

> The glimpses of chemical industry's service to man afforded by this book could be presented only by utilizing innumerable chemical products. The first outline of its plan began to take shape on chemically produced note paper with the aid of a piece of chemically treated graphite held in a synthetic resin pencil. Early corrections were made with erasers of chemically compounded rubber. In its ultimate haven on the shelves of your bookcase, it will rest on a coating of chemical varnish behind a pane of chemically produced glass. Nowhere has it been separated from that industry's products.
>
> The manuscript was typed on a modern typewriter composed principally of metallic alloys. Pressure on its keys of synthetic resin forced alloy type faces against a textile ribbon which left impressions in synthetic dye on paper supported by a chemically compounded rubber roller. Later, the entire typescript was reproduced in manifold through the chemical process of photolithography for review by many persons.
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> Ultimately, the type from which the book was printed was cast in alloy metal, corrected and finally electrotyped by a process involving numerous other chemical products and reactions. Impressions from this type were made with ink consisting of carbon black (recovered from natural gas) in a varnish chemically prepared. The ink was spread upon the type by rolls of gelatin chemically compounded with glycerine and transferred to paper chemically made from spruce trees.
>
> The artists prepared drawings with inks of a different character, but of similar chemical origin, and these originals were reproduced by photochemical engraving to form plates adapted to the purposes of the printer.
>
> The printed sheets, after assembly, were stitched with chemically treated thread, glued with chemical adhesives and bound between pulp boards, chemical products of the forest, decorated and protected by cloth heavily sized with a chemical mixture.—A. P. W.